AMERICAN MACHINIST

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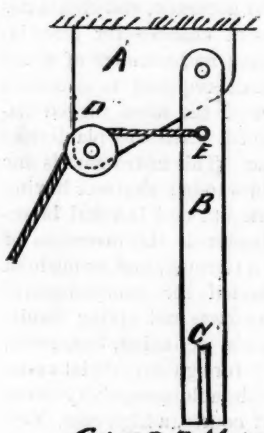
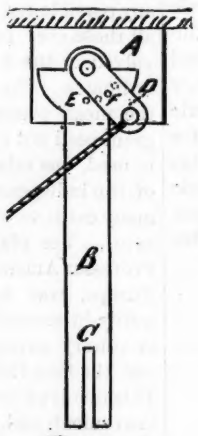
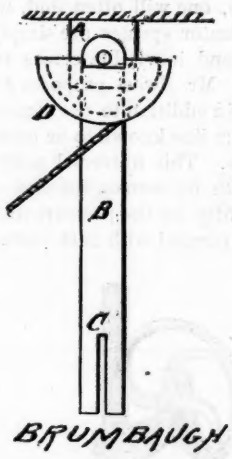


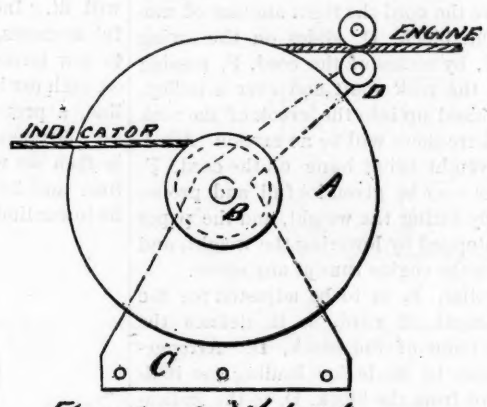
GUIDE PULLEY



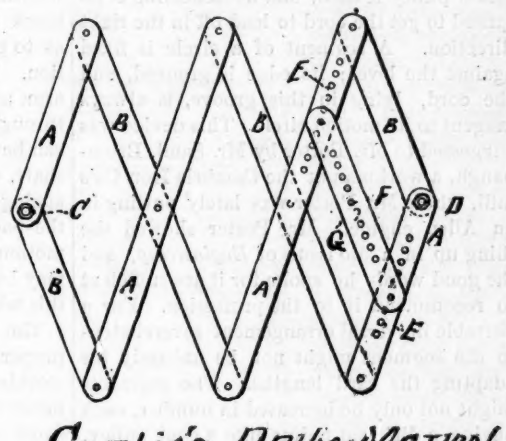
RADIAL.



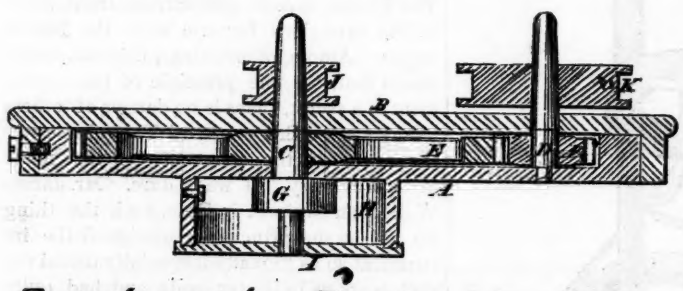
BRUMBAUGH



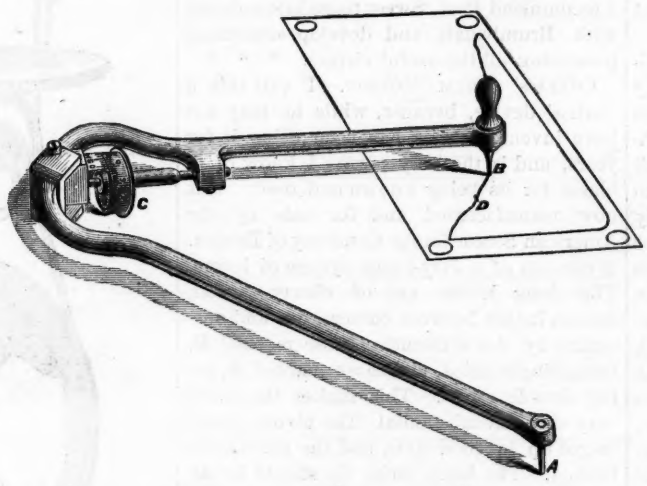
REDUCING WHEEL



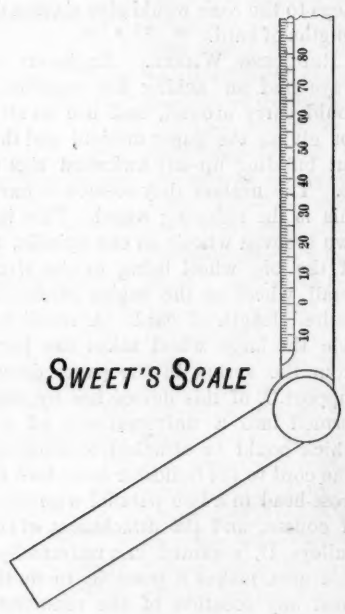
CORLISS'S DRUM-MOTION.



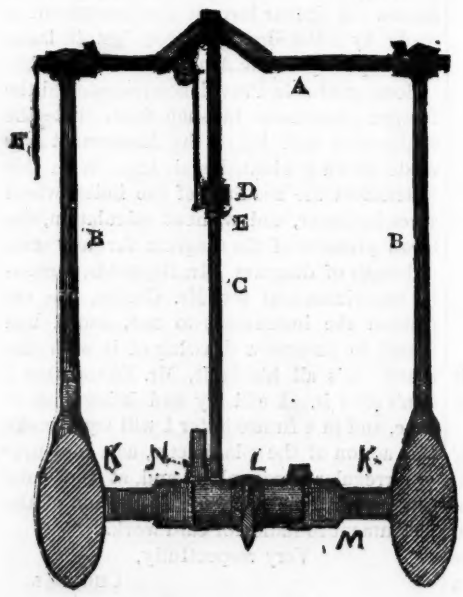
BREVOORT'S DRUM MOTION.



AMERICAN STEAM GAUGE COMPANY'S POLAR PLANIMETER



SWEET'S SCALE



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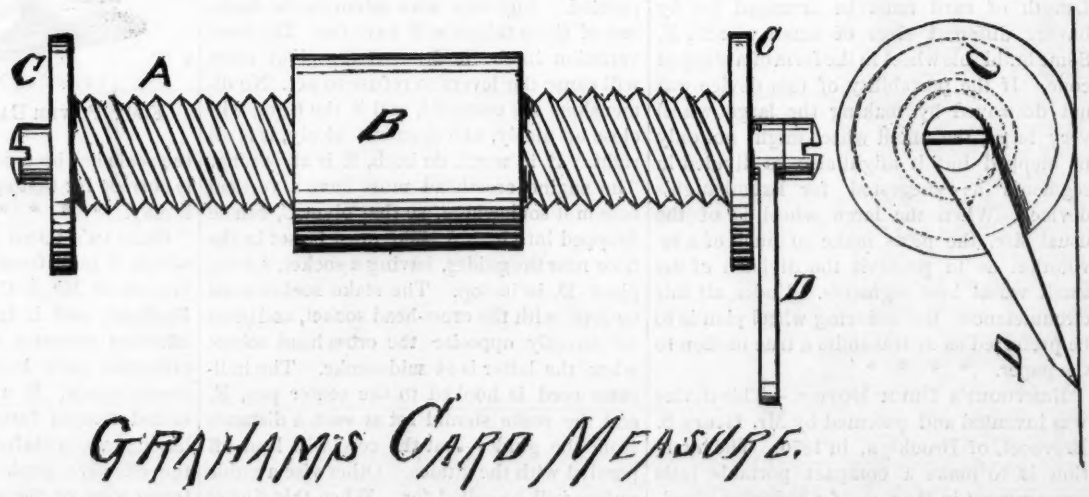


GRAHAM'S CARD MEASURE.

ACCESSORIES TO THE STEAM ENGINE INDICATOR.

Extracts from Chordal's Letters.

Mr. Editor:

As promised in my last letter, I have raked together some of the most important items in the way of accessories to the indicator. They do not cover the whole field by any means. Most every engineer has some useful little kinks which only a few of the interested ones get to hear of. I hope the incompleteness of the present showing will prompt the knowing ones to appear. * * * *

GIVING MOTION TO PAPER. The most common plan of driving the paper drum is by a lever swing from a rig built over the guides. Such a rig is one of the things you can't take along. As variations in the lever plan I show three over the names "Guide Pulley," "Radial," and "Brumbaugh." * * *

LEVER WITH GUIDE PULLEY. It makes no difference how the drum-cord approaches the indicator, but it makes a great deal of difference how the cord leaves the prime lever. No lever motion is accurate, but it is accurate enough for practical purposes. If, in the cut marked "Guide pulley," the guide pulley D was omitted, no harm would result, providing the indicator was at such a height that the cord would be horizontal from indicator to peg E. The slight retardation of the paper motion at the ends of the stroke, may be, or is, in practice, left out of consideration. If, however, with the pulley still omitted, the indicator be lowered about as the cord in the cut indicates, the retardation will commence and close near the end of the stroke, and the consequent vitiating distortion of the card will not be anyway symmetrical on the cards from the two ends of the cylinder. The cord should, to get the best and only acceptable results from a lever motion, be tangent to the circle struck by its motor-point E. With the single point-hitch, this can only be approximated, and is done by making the cord a tangent to its motor circle when at mid-stroke. A guide pulley, as shown, allows the indicator to be moved at liberty without destroying these conditions. * * * *

LEVER WITH RADIAL ARMS. In this arrangement, the hitch-point D may be adjusted by means of peg F and holes E, so that the cord is tangent to its motor-circle at mid-stroke. This, of course, requires an adjustment of the radial arm at each setting of the indicator. Some engineers pre-

fer this rig to the guide pulley. They arrange a slot and adjustable cord-wrist in the radial arm so as to facilitate adjusting length of card. The swinging arm is also gotten up in steel in the telescopic order of architecture, so that, taken altogether, the device can be carted around with the assurance that it can be used most everywhere. A link is preferable to the slot at bottom of swinging lever, but requires more scheming to get up. Getting a good hold for the lever pivot presents the most difficulty. After the device is set up, the cord-wrist is to be adjusted for right length of cord, after which the two proper holes are to be found for the radius peg. These are to be marked, or the others temporarily stopped up. * * *

BRUMBAUGH'S DRUM MOTION is a grand improvement on any of the foregoing. No guide pulley is used, and no scheming is required to get the cord to lead off in the right direction. A segment of a circle is fixed against the lever; its edge is grooved, and the cord, lying in this groove, is always tangent to its motion circle. This device was suggested to Mr. Porter by Mr. Saml. Brumbaugh, a workman at the Cambria Iron Co's mill, where Mr. Porter was lately putting in an Allen engine. Mr. Porter showed the thing up in a late issue of *Engineering*, and the good words he spoke for it are sufficient to recommend it to the profession. For a portable universal arrangement several steps to the segment might not be unhandy for adapting the card lengths. The segments might not only be increased in number, each having a different radius like a cone pulley, but each step might be composed of, say, four segments of different radii. In that way four steps to the cone would give sixteen different lengths of card. * * * *

REDUCING WHEEL. Engineers have always had an aching for something they could carry around, and use on all engines for giving the paper motion, and that without building up any awkward rigs to hitch to. The nearest they seemed to have got to this is the reducing wheel. This is simply two grooved wheels on one spindle, the size of the big wheel being to the size of the small wheel as the engine stroke is to the desired length of card. A recoil spring inside the large wheel takes the hard work from the spring in the paper drum. The support C, of this device has by some been formed into a universal sort of a clamp, which could be attached to most anything. The cord to the indicator must lead from the cross-head in a line parallel with the guides, of course, and the attachment of the guide pulleys, D, mounted in a universally adjustable arm, makes it possible to do this with most any location of the reducing wheel. Length of card must be arranged for by having different sizes of small wheels, B. Some build this wheel in the form of a stepped cone. If the portability of this device was not destroyed by making the large wheel very large, the small wheel might not only be stepped but it might also be divided in segments as suggested for Brumbaugh's device. When the large wheel is of the usual size, the parts make so much of a revolution as to prohibit the division of the small wheel into segments. Under all fair circumstances the reducing wheel plan is to be preferred as it transmits a true motion to the paper. * * * *

BREVOORT'S DRUM MOTION.—This device was invented and patented by Mr. Henry S. Brevoort, of Brooklyn, in 1870. The intention is to make a compact portable little arrangement in the way of a reducing wheel, which will have the advantage of an extra large receiving wheel, while the wheel is, in reality, very small. This is accomplished by using a separate spindle for each of the two cord wheels, and gearing them together, as shown.

The cord wheels are pushed on to taper spindles. Having a number of different sized cord wheels on hand, one may arrange for most any length of cord desired. The cord wheels may be of the stepped cone variety, and thus avoid any shifting to get proper cord lengths. One of the spindles is provided with a recoil spring, G, as shown. The gears are completely encased, and universal attaching clamps and guide pulleys may be arranged as usual. * * * * *

SWEET'S DRUM MOTION.—This is an elegant arrangement of the ordinary swing lever device, gotten up by Professor Sweet, in connection with his new indicator. Its main virtue lies in the fact that the paper drum may be stopped without unhooking any cords. The cut shows the device as attached to Prof. Sweet's very peculiar engine, the lower portion of the cut being a transverse section of the engine frame K. M, M, are the guides, and L, the cross-head with a section of the connecting rods attached. B B are standards, bolted to the engine frame, giving bearings to the hollow crooked rock shaft, A. The swing arm, C, is fast to the rock shaft, and is driven by a projection, N, on the cross-head. A block, D, furnishes a hitching point for the indicator cord. This block rests on the collar, E, at such a point as to give the cord the right amount of motion. The block, D, slides on the swing arm, and, by means of the cord, F, passing through the rock shaft and over a pulley, can be raised up into the crook of the rock shaft, where there will be no motion. A balancing weight being hung on the cord, F, the paper may be given its full and proper motion by lifting the weight, and the paper may be stopped by lowering the weight, and this while the engine runs at any speed.

The collar, E, is to be adjusted for the proper length of cord, as it defines the working point of the block, D. Arrangements must be made for leading the indicator cord from the block, D, to the indicator in a line parallel with the engine guides. Guide pulley, or a substitute must be used. I recommend Prof. Sweet to go into cahoots with Brumbaugh, and develop something possessing all the useful virtues. * * *

CORLISS' DRUM MOTION.—I call this a Corliss' device, because, while he may not have invented it, he has been using it for years, and is the only person I know of to blame for its being known and used. It is now manufactured and for sale by the American Steam Gauge Company of Boston. It consists of a lazy-tongs system of levers. The long levers are of cherry wood, sixteen inches between centers, one and one-eighth by five-sixteenths, those marked B, being single strips, and those marked A, being double strips. This makes the thing very stiff and substantial. The pivots should be got up in good style, and the pivot holes bushed. The hitch strip, G, should be arranged so that it may be shifted in the holes, E, and bring a hitch hole, F, in a line passing through pivots, C, D. The end pivots, C and D, should have a projection below, of say, two inches, with the end somewhat pointed. Any one who attempts to make one of these things will have fun. The least variation in the location of the pivot holes will cause the levers to refuse to act. No dimensions are essential, and if the thing will close up nicely, and open out nicely, it is all right. If it won't do both, it is all wrong. The engine crosshead must have a vertical hole in it somewhere, so that pivot C, can be dropped into it. A stake must be set in the floor near the guides, having a socket, for the pivot D, in its top. The stake socket must be level with the cross-head socket, and must be directly opposite the cross-head socket when the latter is at mid-stroke. The indicator cord is hooked to the center peg, F, and the stake should set at such a distance from the guides that the cord will lead off parallel with the guides. Otherwise a guide pulley will be called for. When this ring is in motion, every point on a line cutting C D has a true motion parallel with the guides, varying in distance from nothing at D to length of stroke, at C. It is only necessary to hitch the cord at a point on this line, which will give the right amount of motion to the cord. This point will be near D, and within the range of adjustment of the strip, G. This is as neat a device as could be wished for. I have seen Mr. Corliss's men hook on to an engine running at a good gait, without stopping. Mr. Corliss, I think, is in the habit of putting a permanent socket into his cross head, and setting a nice standard in a floor socket. Indicator cocks are kept on the cylinder at all times. For a permanent rig on a nice engine, the stake can normally support a neat table top for oil cans and waste. * * * *

FIGURING THE CARDS. This is the heavy work of the expert, and here is where accuracy is to be sought after, and where labor-saving devices come into play. Most plans require ordinates, which are drawn by the common parallel rulers sold with indicators. What may be said about making lazy-tongs will also apply to parallel rules. The least variation from perfection brings the bars "scugee," and the device won't shut up. The work tests itself, and will also put a nice workman to the test. * * * *

SWEET'S SCALE. This is another side issue of Mr. Sweet's radical indicator. It is intended to answer for all scales, and more than that, it will answer for those peculiar springs which, one will often find, no scale will fit. Indicator springs are simply skillful averages, and inevitable errors reduced to low terms. Mr. Sweet proposes to draw on each card, in addition to the atmospheric line, a pressure line known to be correct for say, 50 pounds. This universal scale of his is then set with its zero on the atmospheric line, and its fifty on the pressure line, and its lower limb parallel with both lines. After

[Patented Nov. 16th, 1875.]

FOOT POWER BAND SAWING MACHINE.

the scale has been set to those conditions, it is correct for that spring, be the spring what it may. * * * *

GRAHAM'S CARD MEASURE. This device, which I take from *Engineering*, is the invention of Mr. J. C. Graham of Greenwich, England, and is intended to give the mean effective pressure of a diagram, after the ordinates have been fed into it. A, is a coarse screw, B, a neatly filled nut, C, C, milled flanges fastened to the screw and having a circumference equal to ten times the effective pitch of the screw, and D, a tracer loose on the screw.

To use it, divide diagram by ten ordinates as usual; screw the nut close to a flange, set tracer point at beginning of first ordinate; hold the nut, and roll the instrument along till tracer reaches end of ordinate; then lift the instrument, and without allowing nut to move on screw, set to second ordinate, and proceed as before, and so on through the ten ordinates. When done, the nut will have moved from the flange a distance equal to one tenth the distance traversed by the tracer, and consequently the distance between nut and flange, measured with the proper scale, will give the mean pressure of the diagram.' The use of more than ten ordinates involves a new relation between circumference of flanges and pitch of screw. A thumb screw may be added to the nut to keep it in place while shifting the instrument, etc. This little affair is certainly easy to make, and it is highly spoken of by those who have tested it. * * * *

THE POLAR PLANIMETER. This little instrument, of which the cut is half-size, is used as the cut shows. The point, A, is stationary, and the tracer, B, is moved once over the outline of the diagram. The readings of the index wheel, C, then show the area of the diagram in square inches. This reading divided by the length of the diagram and multiplied by the scale of the spring, gives mean pressure of the card. The demonstration of the action of this simple instrument would require too much space, and I will defer it. The instrument will stand any possible test for accuracy, and eliminates all those ever present chances for error involved in the human measurement of many ordinates. The time required to ascertain the mean pressure of the most ragged diagram need not exceed, when the planimeter is used, one minute. This instrument is one of the indispensables to an engineer having many cards to work up, and is a real labor-saver. The planimeter is the invention of Professor Amsler, a German, and, as made in Europe, was intended for comprehensive utility in measuring areas and giving results in sundry units, such as inches, feet, acres, and the long list of foreign superficial units. This involved considerable complexity in the instrument, and, of course, a high cost. Few in this country ever heard of them, and but two or three steam engineers possessed them. The foreign makers sent horrible translations of the directions for use with the instruments. Among other things, this translation stated that, "as the principle of the instrument is a secret, there is no danger of others being put on the market." This clause was the cause of the instrument being made in this country. It was a dare. Mr. James W. See, an engineer in Ohio, took the thing up, got at the principle, re-designed the instrument so as to make it specially useful for such work as indicator cards, and had quite a number made which he sold and presented to engineers. They are now made by the American Steam Gauge Co., of Boston, and I am informed are sold with nearly all indicators. A similar form of the instrument is made by Elliot Bros., London, but it lacks the simplicity of the American one. * *

Some genius in Providence re-designed the foreign planimeter in such form that the changeable unit leg of the instrument was made into a graduated scale leg. With this instrument the reading of the index wheel gives instanter, and without calculation, the mean pressure of the diagram for any scale or length of diagram. Mr. Reynolds, formerly superintendent for Mr. Corliss, has explained the instrument to me, and I had hoped to present a drawing of it with this letter. It's all his fault, Mr. Editor, that I don't send it. I will try and bring him to time, and in a future letter I will try to make the action of the planimeter, as a measurer of irregular areas, plain, and, at the same time, show the Providence adaptation of the instrument to indicator card work. * *

Very respectfully,

CHORDAL.

Foot Power Band Sawing Machine.

We illustrate on this page a new style of foot power band sawing machine.

The parts are very few, and the construction, as may be seen by the engraving, is simple. The principal pieces of which it is composed are an upright standard, which, by means of suitable feet, is bolted to the floor; two brackets carried by it, which sustain the wheels; the wheels which carry the saw, a treadle, crank, and fly-wheel.

The saw employed is of the type ordinarily used upon band sawing machines, and runs upon wheels in the usual manner. The principal bracket carries an arm which holds the guide. A pulley on the shaft of the lower wheel is belted to the driving wheel, which

in turn is driven by the crank connected with the foot treadle.

The saws used in connection with this machine are made thinner and finer than those used in the large machines, and are tempered by an entirely new process. The success attending their manufacture has been so great that the makers feel justified in warranting them from breaking.

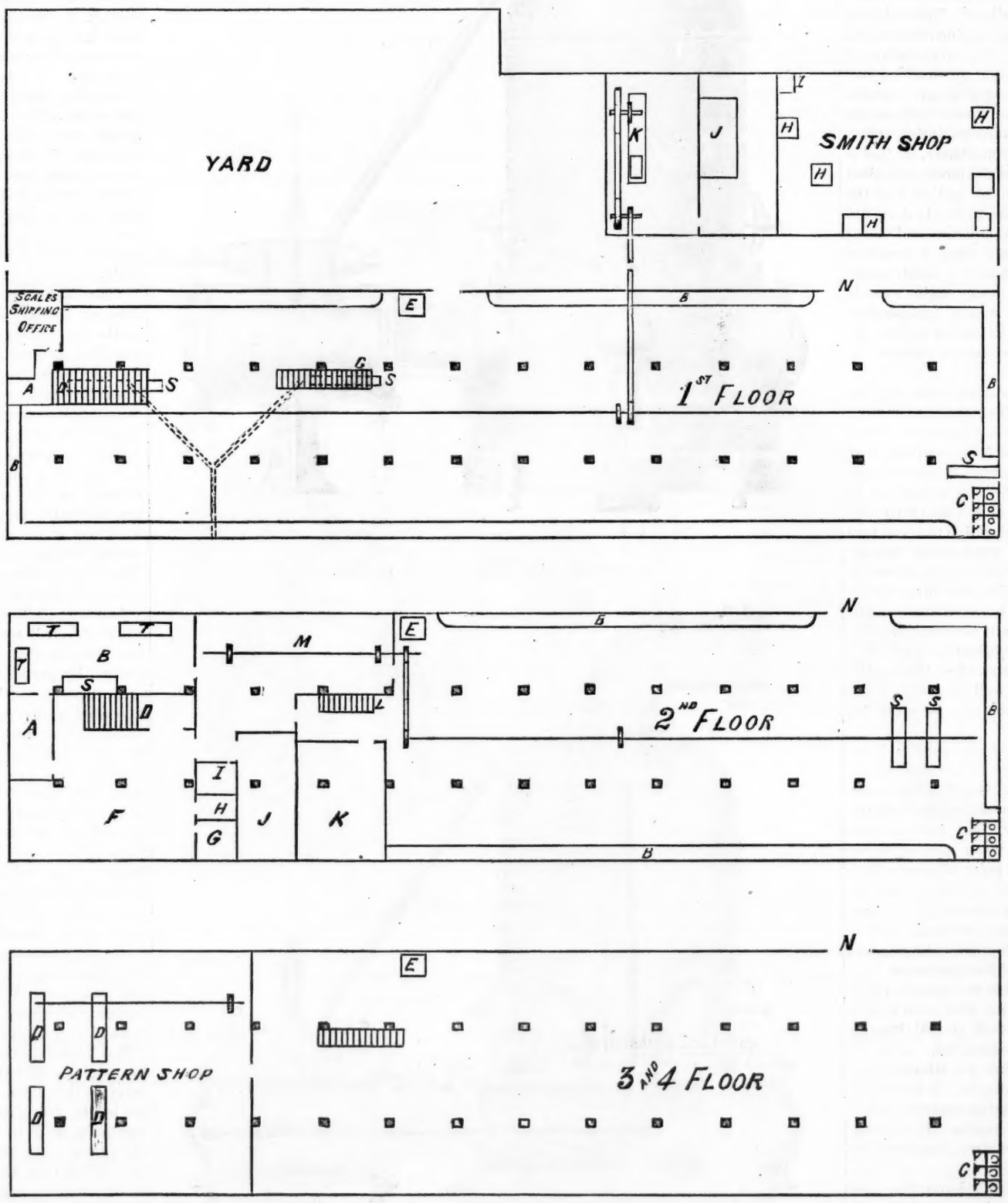
The manufacturers claim for this machine that it is the only one that can be run with equal success by either foot or steam power. It is also claimed for it that it can do the finest, as well as coarse and heavy work, being adapted to use in the finest toy work and upon heavy lumber. It is manufactured by Messrs. Kimball & Kimball, 639 Arch street, Philadelphia.

Machine Shop Architecture.

In our issue of Oct. 11, 1879, we illustrated a model machine shop for the manufacture of small tools, also in reference to the general arrangement of the shop, and systems of doing work.

In this issue we illustrate the plan of a shop designed expressly for press and die manufacture. The buildings which have just been completed, are occupied by the firm of Bliss & Williams, Brooklyn, N. Y.

By aid of the accompanying illustrations we will describe the shops of this firm, also some of the ways in which the work is done. The building is 50 feet wide, by 200 feet long, and is four stories high. The fourth floor is used as a store-room for patterns exclusively, and is arranged in a systematic way, so that any pattern can be found at once. The third floor is largely used as a fitting-up, and store-room for machinery. The pattern-shop is 50 ft. × 50 ft., in which D represents work benches. It is well furnished with lathes, saws, and other tools. A good light enters on three sides of the building, which enables the workmen to do more and better work than if there were less light. This shop is furnished with an elevator, E, for light machinery, and an outside hoist, N, for heavy machinery.



The second floor is used principally for die making. There are forty machines on this floor, consisting of lathes, planers, drill-presses, and milling machines. The vise benches are constructed with an opening at the back, by which the heated air coming from the pipes under the bench, can escape without inconvenience to the workmen. The little squares which appear on each floor represent posts to support the other floors and the roof.

The private office is represented by A, the drawing-room by B, while T T represents drawing tables, S, a closet, D, stairway to general office, F, main office, G, closet, H, coat room. The offices are very pleasant, well lighted and heated. The closets represented by I are continued in the same order to the third floor. The sample room J is worthy of a special notice, for it contains specimens of the work done by the machines and dies manufactured by this firm. To illustrate: when an order is received for a machine or die to do special work;—when the machine is completed, a specimen of the work, marked with the name of the purchaser, with date, etc., is filed away in the sample room, so that if a duplicate is desired at any time it can be furnished by referring to the specimen. In this room are specimens of some of the most intricate work done in tin and sheet iron. A visit to the sample room is quite a treat to men engaged in the manufacture of shell metal goods, on account of the numerous designs. The tool room is shown at K, which contains a full stock of tools necessary for use in the different branches of the work. The check system, formerly described in the AMERICAN MACHINIST, is in use here, and a small dumb waiter and a speaking tube communicate with the different floors, making it unnecessary for the workmen to go from one floor to the other in order to procure tools. The show room M is used for storing the finer machines when finished, and is also used, as its name implies, for exhibiting goods. The wash sinks, S S, are arranged with a perforated pipe running over the top of them, so that in washing each man can have clean water. There are a number of peculiar machines in use on this floor which were designed in the shop, and as it is not probable that they will be illustrated, it may not be amiss to describe them. One of these is an upright milling machine, of a kind not found in the market, adapted to the kind of work required. The upper part of the machine resembles a drill press, with the boxes so made that all lost motion of the spindle may be taken up. In place of the table on the ordinary drill press is an attachment, something like the table on a slotting machine, so that, by means of the usual screws, it may be fed in all directions, or in a circle by means of a worm and wheel. This machine is used for milling out all irregular shaped dies, such as ovals and segments of circles.

These machines possess a large capacity, and it is claimed, that a square hole may be milled upon them. We would like to show a cut of the machine here, but they are built only for use in this shop, and are not for sale outside. Another machine worthy of notice is a universal grinding machine, in which the emery wheel that does the grinding can be adjusted in any direction, to suit all angles. A piece of work must indeed be of a very curious shape, which could not be handled upon this machine. A set of dies have lately been made in this shop for making metallic shingles.

We noticed a very useful device applied to a lathe by which round dies may be ground inside, and finished after being hardened. The die is bolted to the face plate, and must be set so as to run perfectly true. A small emery wheel is attached to the tool post; when the lathe is started, the die revolves, and the emery wheel, which revolves in the opposite direction from the lathe, is fed in and out of the hole in the die until it is finished. The special tools, used such as gauges, dies, and reamers, are all made in the shop. The first floor contains all the heavy tools, 54 in number. The main entrance to the shop is shown at A, and D is the stairway to offices and second floor, while G is the stairway for the use of shop men, and communicates with the different floors. The vise benches, B, are continued all around the shop, and the machines are grouped near the center of the floor, which is believed to be the best way to suit the class of work done in this shop. The smith shop is 33 feet x 44 feet, and contains five single forges and one double, and is fitted with the necessary cranes and other appliances usually found in smith shops. Next to the smith shop is the boiler room, which is 16 feet x 33 feet, in which J represents the location of boiler, which is of a return tubular pattern. The chimney, I, is shown in the corner of the smith shop. The engine room adjoins the boiler room, the size of each being the same. In the former K, represents the engine, 13″ x 34″. The space between the machine shop and engine room is about 20 feet, which is represented closer in the engravings to save space. The general arrangement of shaftings and belts is also shown. The dotted lines represent the position of drain pipes. The shop is heated by four lines of 1¼″ pipe placed upon hook plates under the benches. Each section of pipe is "connected with a manifold," by means of which a quick and good circulation is always secured. Exhaust steam from the engine is used during the day, and the pipes are so arranged that live steam may be used directly from the boiler at night or in the morning, when it is required to heat the shop, and the engine is not in use.

Since the first successful attempt at making tin pans from a whole sheet of tin, which was made about twenty-five years ago by the use of a drop hammer, the demand for tin ware has been rapidly increasing, and at the present day the immense business done in canned goods necessitates a constant change in the present patterns, and the devising of new ones. The firm of Bliss & Williams began business without a drawing or a gauge of any kind, and went to work with a zeal which has since distinguished them in their line of business. At the present time they have 100 machines in use in their shop, and employ a system by which any machine or piece of work can be duplicated. They manufacture tools ranging from the lightest to the heaviest work—embracing, dies, soldering machines, tinsmiths tools, stamping presses, and many others of like kind, which are sold in nearly all parts of the civilized world.

The Pulsometer Engineering Company, of 61 Queen Victoria Street, London, are manufacturing patent differential pulley blocks, of which more than 20,000 have been sold.

An Improved Condenser for Non-Condensing Engines.

In our issue for March, 1878, we published an illustrated description of Hamilton's Independent Air Pump and Condenser, which attracted considerable notice from users of steam power, and developed such a prolific crop of inquiries, that the manufacturers, Sawtelle & Judd, Hartford, Conn., have found it desirable to make some new engravings exhibiting a sectional view, also a view of the condenser attached to an engine which we show, together with the side view on pages 4 and 5.

As a number of these condensers are now in use, the builders have something upon which to base their representation of a great saving in fuel, or an increase of power at a small cost where water is available. This valuable attachment to the steam engine removes the back pressure, which is a large factor of waste in an ordinary high pressure engine. In doing this, it forms a constant vacuum equal to 13 or 14 lbs. per square inch on the exhaust side of the piston, its entire stroke. It can be set up by any mechanic, all that is necessary being to select the most convenient place for water connections, and to lead the exhaust from the engine to it. It does not require any masonry foundation and occupies no more floor space than a common steam pump. In operation, it is nearly noiseless, and being located in the engine room is unobjectionable. It is wholly independent of the engine, and can be started to free the cylinder from water and form a vacuum before starting the engine.

One of its offices is to assist in the regulating of the engine, as when the load is variable. No steam pump is required to lift its injection water, as it lifts from any point that can be reached by the pumps in general use.

It is claimed that the power required to run the condenser is not more than two or two and a half per cent., against five to seven per cent. in the ordinary condensing engine, with its air pump. Moreover, this power is not taken from the engine, but direct from the boiler. The water required for the condenser, it is claimed, will be about twenty-five times the amount required for the boiler; and the condensing water after leaving the condenser for the hot well should be about 100° temperature, which can be used for boiler feed.

When a close heater of any pattern is already located, it need not be laid aside in applying this condenser, as it will act as a surface condenser between the engine and the independent condenser, and increase the temperature of the feed water so it can be returned to the boiler at a point of nearly 150°.

It can be adjusted to the exact work required, and a single condenser can be used for two or more engines, or pumps, one or all of which may be stopped without interfering with the action of the condenser.

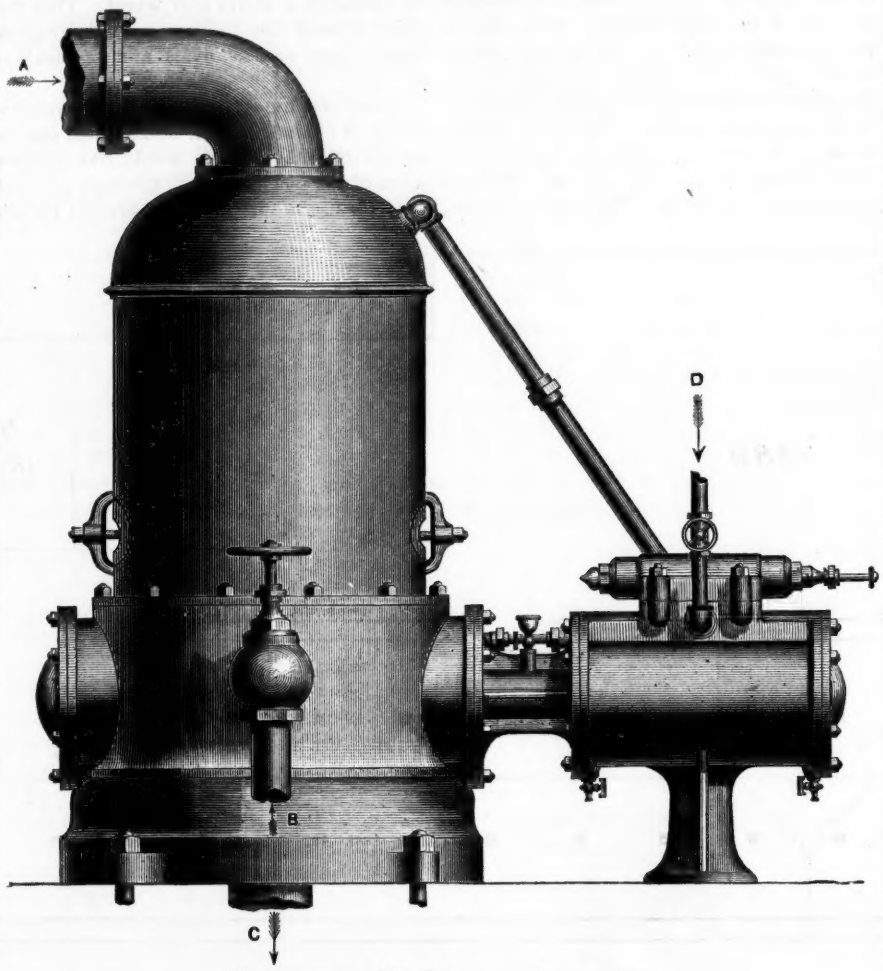
As shown in illustration on opposite page, it can, by the use of two gate valves, or a three-way cock, be shut off at will, leaving the engine simply non-condensing.

The condenser requires no attention beyond starting and stopping it. It is equally applicable to non-condensing engines, and to vacuum pans of sugar houses. It can also be applied to marine engines, employed in lake or river navigation.

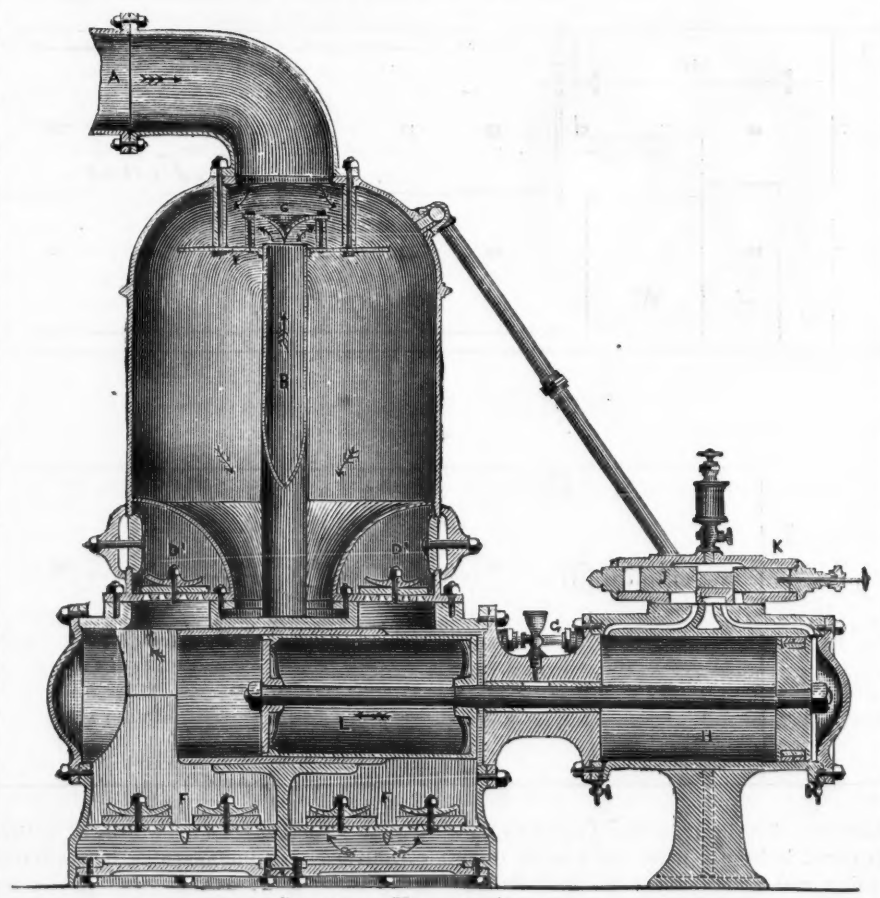
The illustration on page 5 shows this condenser attached to an engine. A, is the exhaust pipe, B, the injection pipe, C, waste pipe or overflow, and D, steam supply pipe from boiler.

The exhaust pipe, A, has valves to connect or disconnect condenser from engine, making it a condensing or non-condensing engine, without stopping the engine.

When the condenser is required to be used, the injection valve is opened, and steam is let on to the steam cylinder of condenser to operate air pump. When sufficient vacuum is formed to lift the water in injection pipe, B, (as seen in sectional view, page 4), the water is carried up through pipe B, to the deflector, C, and falls on the perforated plate, E, to distribute the water in condenser; at the same time the exhaust steam is being drawn by vacuum through exhaust pipe, A. The contact of the steam with water at once condenses the steam, which water falls into the cone (shown by direction of darts) to the bottom of base of condenser. The vacuum formed by the plunger of air pump, L, operated by the steam cylinder, H, lifts the water from the lower part of base of condenser through induction valves, F, into space around plunger, L, and on the return stroke of plunger, L, is forced up and out through eduction valves, D, to waste pipe, C, which is shown in the first engraving.



INDEPENDENT AIR PUMP AND CONDENSER.



SECTIONAL VIEW OF CONDENSER.

The piston in steam cylinder, H, is operated by the piston slide valve, J, in steam chest, K, the whole governed by a tappet rod, G, which determines the stroke from both steam piston in cylinder, H, and air pump plunger, L, giving it a regular and positive stroke, which is at all times ready to start without reversing the valves.

The following is a summary of the advantages claimed.

1st. It being independent from the engine, can be changed, without stopping the engine or condenser, to non-condensing.

2d. It can be started before the engine, to free the cylinder from water and form a vacuum in the condenser.

3d. It can be adjusted to the exact work required.

4th. It requires no attention beyond starting and stopping.

5th. It can be set up by any mechanic.

6th. It can be set in any place convenient to water.

7th. It requires no foundation.

8th. It is the cheapest and simplest form of condenser known.

9th. There is no liability for it to prime the engine cylinder and cause the serious accidents so common in some other forms of condensers.

Compressed Air.

No. IV.

BY JOHN FISH, M. E.

Next in importance to cooling compressed air thoroughly, is some efficient method of packing the piston of the compressed air cylinder. And here there seems to be as great a diversity of opinion as to the best method of accomplishing this end, as there is in the general plan of the machine itself. One of the leading manfacturers of these machines, in this country, packs the piston in the same way that an ordinary steam piston is packed, using, of course, great care in the accurate fitting of the packing rings; for a leak in the air-compressing piston is a matter of much more serious importance than it is in a steam cylinder piston, and it seems to be a much more difficult thing to overcome.

Should a jet of water be used to cool the air in the cylinder, the water accomplishes at the same time another object; that is, it lubricates it also; but, should the air be cooled on the dry system, that is, by a water jacket surrounding the cylinder, the air cylinder may be lubricated by oil, if the pressure of air ranges very high, and by some makers it is fed into the cylinder automatically.

There is another plan of packing air-compressing pistons, where the cooling is done on the dry system; that is, the packing rings are made of a vulcanized material, which is a good non-conductor of heat, and seems to possess wearing qualities for this special purpose equal to metal. Where this packing is used it is generally lubricated by water, which is forced through a hole bored through the piston-rod (which is prolonged through the back cylinder head) into the piston, the water circulates through the cored chambers of the piston, keeping it cool and around the piston rings, which it lubricates. This is a very neat and ingenious method of accomplishing the end in view.

Another plan of packing piston rings where the air is compressed on the "dry system," is one that has been used with great success by parties who have had considerable experience in building these machines. It is used on that class of compressors where a single acting trunk-piston is used. There are two leather collars or rings (such as are used on hydraulic cylinder presses) placed with their feather edges reversed; the cylinder trunk stands vertical, water circulates around the outside of the cylinder in the jacket, and is conducted by a pipe to the inside of the trunk piston; by this means the leather rings in the pistons are always kept moist, and the cylinder and piston cool. It is claimed by the makers that this is the only way that a compressed air cylinder piston can be made absolutely tight, and be kept so. When properly put in, they certainly give very little trouble, and have worked very successfully.

It is possible that an air-compressing piston might be made to work successfully, by carrying the piston rod through both cylinder heads, fitting deep bushes into the stuffing boxes, so as to form bearing guides for the piston and piston-rods, so as to relieve the cylinder of the weight of the piston; which might be made in length equal to its diameter at the least, or even longer, if possible.

A light spiral packing ring could be fitted into the periphery of the piston, water forced down a passage in the center of the piston-rod, connecting to the center of the piston, could be used to lubricate the piston packing-ring; and also cool the piston. A piston fitted on this plan would be admirably adapted for high speed; the contact of the metal packing would be spread over a great length of surface; the piston, being extra long, the water inside of the piston would lubricate the packing-ring, and would form a very efficient packing in the interstices between the rings.

The frictional pressure of the packing would be very light, adding greatly to its wearing quality.

Is Steam Engineering a Fine Art?

BY WM. J. WILLIAMS.

Editor of American Machinist:

Burton, in his "Anatomy of Melancholy" says: If that severe doom of Dionysius be just, it is a greater offense to steal dead men's labor than their clothes; what, then, shall become of most writers? If I was to undertake to write up an article or two on the theory and practice of steam engineering, I would be very apt to steal some dead or living man's thunder, for the very good reason that I have not the means with which to add from self-practical observations of the fine art part of the business, to say nothing about ability. Since the subject has received particular attention from several of your contributors, and among the foremost, our friend, Mr. Church, who, by the way, gave a fair warning the other day to those who might feel disposed to tread on the tail of his coat, that he keeps a double-barrel shotgun handy, and he has not thus far intimated he has parted with it, or had it beaten into ploughshares, or pruning hooks, until I receive undoubted proof that he has done one or the other, I shall be very quiet on the subject, until I believe I have something new in the fine art part of the business. Nevertheless, I have some recollections about the matter as it was actually practiced in certain places with which I was at the time acquainted.

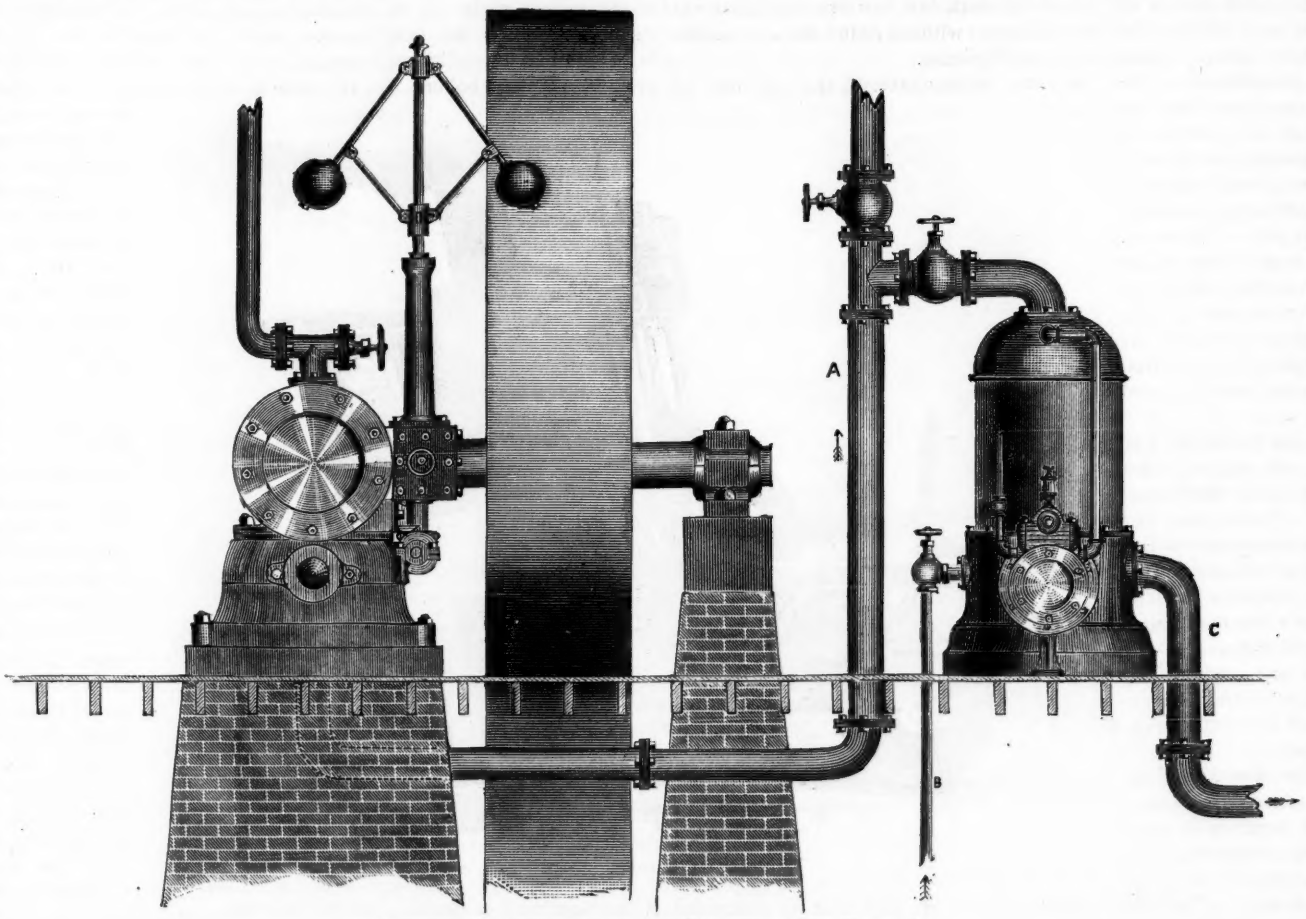
Nearly thirty years ago, a certain mining company began prospecting for copper not a hundred miles from Philadelphia. After sinking their shaft a short distance it became necessary to employ steam power to pump out the incoming water. The company bought a second hand horizontal slide-valve engine (9″ × 18″), and employed a man to erect and run it, who, from his own statements, (which he was not slow to be let known) was both machinist and engineer, and had great experience with locomotives and steamboats. A stationary engine was almost beneath his notice; he had a temper not to be trifled with, and, as a gentle reminder to those who felt disposed to question his importance, he carried a Colt's revolver in his hip pocket. Well, he erected the engine and set it to work. By the great "Jerusalem," the exhaust from one end of the cylinder could be heard of a still night for a distance of two miles, while the exhaust from the opposite end could be heard not half the distance! In this condition it worked (a period of many months), until the company abandoned their explorations. Various were the surmises by the employees of a neighboring company, as to what could be the matter. Some suggested that the cylinder was too long for the stroke, due to the crank's length; that while the piston was in the proper position in the cylinder for the commencement of one stroke, it was a considerable distance from the opposite end, at the termination of the stroke; and that this space (clearance) required such an extra volume of steam to fill it, coupled with the amount required to drive the piston to the opposite end, as to cause the awful roar at every other stroke. Many were the anathemas, loud and deep, pronounced by otherwise quiet-loving citizens. No one dared to inquire the cause of the unseemly noise of the person who ought to have been the best acquainted, for fear of that hip pocket's contents. Suffice it to say, the engine was reerected, after being sold, by another person in another place, and it behaved like a well-regulated machine. So much for steam engineering in that place.

We engineers fall into strange places sometimes, and often get twitted because of our ignorance in theoretical matters. We have to deal with what we find, and one situation, or the difficulties therein found, is often a lesson for life. Owners of steam engines generally act, at least, as if the builder had done all the fine art part of the business; and, consequently, the man whose fortune or misfortune happened to place him in the position to *take care* of the perfect machine, had nothing to do but to start her up and then sit down in his arm chair and read the news of the day. I call to mind an 11″×30″ horizontal slide-valve engine, so loaded down with work, pumping water; making ninety revolutions per minute, burning nearly five tons of coal in twenty-four hours; condition, horrible; but no stop could be made longer than to pack a stuffing-box; any longer time was almost equal to an abandonment of the place. Occasionally the feed-pipe would get choked between the heater (an open one) and boilers; pine plugs, of sufficient size to suit the top of exhaust pipe, were constantly on hand. When the feed-pipe would get choked, it was a regular proceeding to shut down the engine, take a plug and a hammer, get on the roof and drive the plug into the exhaust pipe; get down as quickly as possible and with the starting-bar chuck the steam into her, forwards and backwards, until there was almost a clear boiler pressure from boiler to top of exhaust pipe. By and by, the plug would be forced out with a report like a small cannon, spinning heavenward higher than the tall oak trees surrounding the place. If one trial sufficed, well and good—go ahead until the next time. That was fine art steam engineering with a vengeance! Talk of adiabatic curves, re-evaporation, cylinder efficiency, etc., under such circumstances!

Mr. Editor, you must not think that these are observations of by-gone days, and that we are all so much wiser now, and consequently do things better, for it was not long ago that I saw a place where, when the water got down in the boiler, they would stop the engine, let off the steam, take out the safety valve and pour water in with buckets to fill the boiler again.

Several years ago a certain M. E. used to talk largely of what economical engines he could build if he could have the opportunity. He represented his ideas as entirely new. It is said that every one's opportunity comes if he will only use it. His came: He built a beam engine of about 24 inch bore and 6 feet stroke, for the purpose of pumping water. The pump rod was attached to one end of the beam; the cylinder was placed above the other end, and had one head only, and this was the upper end; the beam was connected to the under side of the piston by a connecting rod, terminating at the beam in the usual manner. Steam was admitted to the upper side of the piston, forcing it downward, also the end of the beam underneath, and thereby raising the pump rod at the other end. On the termination of the stroke, the steam was allowed to escape by an independent valve, when the weight of the pump rod would cause the piston to return to the upper end of the cylinder, and in position to make the next stroke. Now, be it remembered, that the whole of the inside of the cylinder, except that part occupied by the piston (and the under side of it) was open to the atmosphere. How about cylinder efficiency in this form of engine? Very early in the beginning of the present century, there was such an engine at a copper mine in the west of England, but who would have thought to have found one in the United States in the latter half of the 19th Century being represented as something new?

In some rambles around town I met with some queer looking steam engines, and in very odd positions located in such places, yet I suppose the builders expected them to be kept in A No. 1 condition, and to have some first class engineering done, without themselves having made one solitary provision for doing it. As a contrast I found one engine room with painted walls displaying some half dozen good size chromos, and having a large plate glass mirror hanging on the wall in such a manner, as to reflect everything in the room. The floor was covered with oil cloth. There was a small round table of fancy design on which were nickel plated oil cans. The engine was probably about 18″ x 30″, a slide valve, and running at a moderate speed. Here now I would expect to find some fine art engineering.



CONDENSER ATTACHED TO AIR ENGINE. (SEE PAGE 4.)

Boiler Proportion and Construction.—Heating Surface.

BY WM. H. HOFFMAN, M. E.

The evaporative power of all boilers must be measured, of course, by the efficiency of their surface exposed to the fire in transferring the heat from without the plates to the water within them. Heat reaches the plates by radiation and contact. The contact comes from the solid fuel, the radiation from the flames and gases.

Water has a weak conducting power, and, if heat is applied to its upper surface, it does very little toward warming the water beneath, and, for this reason, the heat should be applied to the bottom of any vessel to produce the most effect as to evaporation. In case the enclosure is surrounded by water, the heat being applied from within, the greatest amount of evaporation takes place at the top of casing. Where the water is within and the fire without, the best surface is the curved style of crown sheet of a locomotive boiler. The next best surface is the horizontal plate, though seldom used on account of its weakness in design. The next in efficiency is the large cylindrical tubular boiler shell (the under side), where the heat first strikes it. The top inside surface of tubes and flues has also high evaporative power. The bottom of a tube or flue evaporates very little water, as the water will not leave the under side of the tube unless driven away by forced circulation. With a 3¼″ tube there is six times more water evaporated directly *over* the tube than at a point directly *under* it, while the sides of the tube will evaporate a little more than one-third of the quantity evaporated at the top of tube. I am now speaking of boilers that pass the heat *through* the tubes. Then, again, the heat does not travel in true parallel lines through the tubes, but has *wave curves*, with a decided tendency to hug the upper side of tubes.

Where the water is in the tubes, and the fire and heat around them, the order of things is reversed, and the bottom side of tubes is the most powerful generator, the top side yielding a very small evaporative duty.

Sectional boilers, with water tubes inclined to induce circulation, give the greatest evaporative power, but the life of them is much shorter than the shell and fire tube system. A properly proportioned and constructed *fire* tube boiler will evaporate from 9¾ to 10 lbs. of water per 1 lb. of coal, and a good sectional *water* tube boiler will evaporate between 11 and 12 lbs. of water per (1 lb.) one pound of coal, both systems working under the same conditions as to grate surface, firing, feeding, etc.

The shell fire tube boiler will last, with ordinary care and fair feed water, twenty-five years, and very little repairing will be needed during that time; but a sectional boiler of same capacity will fail, with the best of care and feed water, inside of twelve years, and frequent repairs will be necessary at the joints and connections.

I speak of the sectional water tube boiler as it is generally designed and constructed. Further on in these papers I shall speak of the sectional system at length, though I will here say that I believe that no water tube should be less than 5″ in diameter; else, when arranged on the sectional plan, the water will be driven from the lower courses of tubes and the metal burned to an injurious degree. When a *shell fire* tube boiler is well designed and proportioned, nine (9) square feet of heating surface will produce a horse power, with an allowance of one (1) square foot of grate surface for every thirty-two (32) square feet of heating surface.

I shall have to leave further consideration of this subject for another occasion.

An Easy Method of Calculating the Loss in Long Steam Connections.

BY WM. MAIN.

It often happens in manufacturing and mining operations that steam must be carried a long distance. Pipes are sometimes well protected, more frequently covered insufficiently or not at all.

The constructor, or engineer in charge, speculates as to the amount of steam lost, or even goes so far as to put a steam gauge at the far end of the long connection, and compare it with that on the boiler. If, as usually happens, the difference of pressure is but slight, he concludes that but little power is lost, and troubles himself no farther. If the boiler gauge indicates 100 pounds, and the other 95, it is often assumed that the loss is but 5%.

A more fallacious conclusion could hardly be reached, and it is strange that it should be so common among intelligent men.

It might happen that one-half of the entire power of the boiler is expended in keeping a pipe full of steam, and yet not more than a difference of one or two per cent. be shown between the gauges. The condensation or shrinkage of steam in the pipe relieves the boiler and affects the boiler gauge almost simultaneously with that at a distance. The difference in pressure is occasioned only by the friction and inertia of the column of steam as it is pushed through the pipe to supply the waste. No one would expect a steam gauge to indicate different pressures if connected with different parts of the steam space of a boiler, even though they might be differently exposed to cooling influences; but all open steam connections may be considered as part of the steam space of the boiler, and, but for friction and inertia, would be subject to the same pressure however long they might be.

It is obviously impossible to tell, by any simultaneous comparison of gauges, what the boiler gauge would have indicated under different circumstances. Neither can any reliance be placed upon estimates of the loss based on the amount of water trapped off, as the steam condensed by lowering the temperature would appear as a fire mist, but a small fraction of which will settle.

It is, however, easy for any engineer, by the use of a single gauge and a simple calculation, to ascertain the real loss with a considerable degree of accuracy.

The steam gauge is to be attached to the pipe to be tested at any convenient point. The pipe must be allowed to attain its usual working temperature, and the connection with the boiler closed. The reading of the gauge must be taken at this moment. At the end of a definite time, the reading of the gauge is again noted, and the difference obtained.

The trial should be repeated several times, varying the length of time between the readings, and allowing some little time between the trials, so as to be sure that the pipe at the time of closing the valve is at its usual heat. The pressure may also be noted exactly at the end of each quarter minute, and the average rate of decrease obtained. This will tend to correct errors due to stiffness or irregular working of the gauge, which would affect more seriously single observations. If now the cubic contents of the pipe, or other steam space on trial, is known, it will be an easy matter to calculate the loss in horse power. The steam might have been used to fill a cylinder under the highest pressure noted. If, at the end of a certain time, the pressure has fallen 25 per cent., it would indicate that a corresponding proportion of the steam in the pipe, at the initial pressure, had been condensed, or, what would amount to the same thing in calculation, that the whole contents of the pipe or steam space had been lost at a pressure equal to the difference between the two readings of the gauge.

The pressure on a square foot would be 144 times that, or a square inch; and a cubic foot of steam, generated under the pressure indicated, would lift an equal number of pounds one foot high. If, now, we multiply the proper proportion of the contents of the pipe in cubic feet, by 144 times the highest pressure, we will have the total number of effective foot pounds lost during the time of the experiment. Or, if we multiply the total contents of the pipe by 144 times the difference of pressures, we will have the same thing.

As a horse-power is 33,000 pounds raised one foot per minute, the number representing the lost foot pounds must be divided by the product obtained, by multiplying 33,000 by the time during which the rate of condensation was observed, expressed in minutes or fractions of a minute. The quotient will be the horse-power lost without estimating expansion. If a cut-off is used on the engine driven, a percentage must be added corresponding with the additional percentage of power due to expansion.

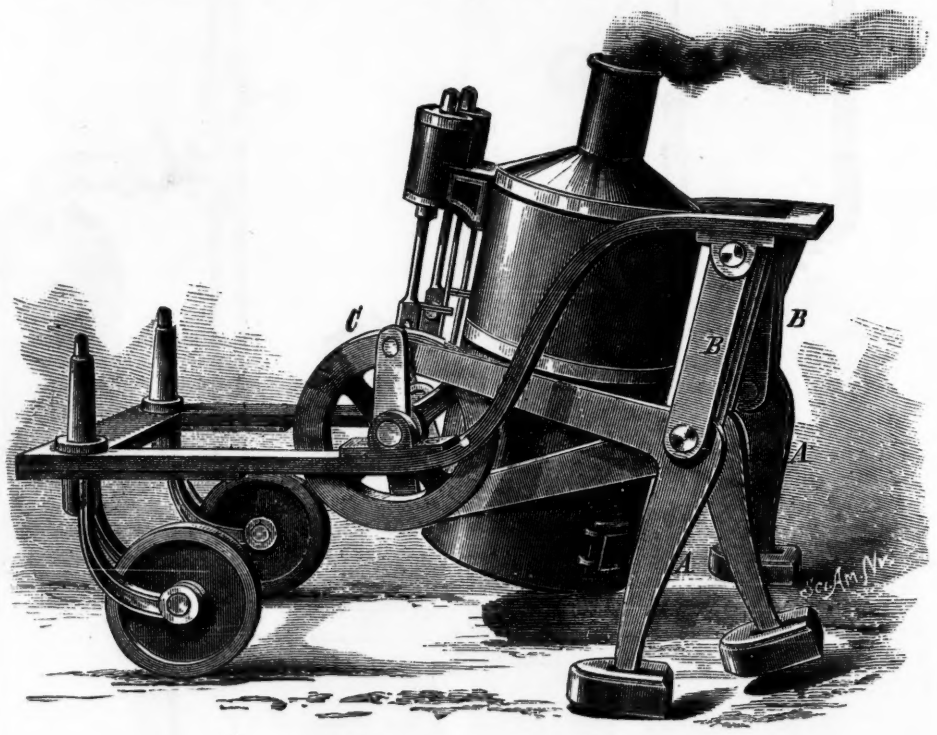
A practical result can be reached in any particular case when the amount of steam, at full pressure, lost in a given time, has been estimated. Knowing the amount of steam admitted to the cylinder at each stroke, the number of additional revolutions that the lost steam would have caused in that time can be calculated. Comparing that with the number usually made, the proportion of the work lost for any particular engine is known without round-about measurements and figuring.

It must be remembered that the rate of condensation in the pipe is at its maximum at the moment the connection with the boiler is closed, and becomes steadily slower as the pipe approaches more nearly the temperature of the outer air. On that account the time of observation must not be too prolonged, especially with uncovered pipes, or the result will be too low. If too short, a lack of sensitiveness in the gauge will also cause an under-estimate of the steam condensed. With a little judgment and a good gauge these errors will be small. A number of trials should be made varying the time and the results compared.

I will give a couple of formulæ to sum up with, though, as they contain nothing not previously explained, those that abhor the sight of such things can skip them.

Let C represent the contents of the pipe in cubic feet; p, the pressure at the time the valve is closed; p', the pressure after a certain time; t, the length of this time in minutes; then $\frac{C \times (p-p') \times 144}{t \times 33{,}000}$ = horse-power constantly lost without estimating expansion.

Further: If "c" represents the contents of the cylinder at the point of cut-off, then $C \times \frac{p-p'}{p}$ divided by $2 \times c =$ the number of extra revolutions that the condensed steam would have given in the time t. If two gauges, agreeing under equal pressures, differ when placed, one on the boiler and one at the end of the long pipe, this difference is due to friction or "wire drawing," and the percentage lost must be added to that obtained from the above formulæ. Results obtained by steam users, under different conditions, would, if published, be of value to the public.



THE STEAM HORSE. (SEE PAGE 8.)

Letters from Practical Men.

1514 Hough Avenue,
Cleveland, Ohio.

Editor American Machinist:

Your issue of December 6th has an illustration by L. F. Lyne, M. E., of the ruptured portion of the fire-box of the locomotive "Lehigh," which exploded in the Hoboken, (N. J.) depot, Oct. 28th, 1879.

The explosion is another illustration of the present pernicious practice of bracing, now too extensively adopted in fire-box boilers.

Repeatedly has it been shown by carefully conducted experiments that, next to material of good quality, combined with proper workmanship, the *quality* of *flexibility*, or, in other words, such an arrangement of parts as will admit of their freely assuming such variations in form and dimensions as may be induced by variations in temperature and steam pressure, is the most essential quality in promoting durability and preserving the integrity of steam boilers. At the same time it has been as incontestably shown that the absence of the quality of flexibility by injudicious use of bracing, etc, producing rigidity, has been productive of more damage than all other influences combined, to which steam boilers are ordinarily exposed. That these assumptions are true, are sustained by sound reasoning, by experimental tests, and more or less by every boiler explosion that has been recorded, no competent authority will deny.

In the whole catalogue of steam boiler explosions, I will venture to say, not one can be found so eminently adapted to expose the unsoundness of the reasoning to which is justly chargeable such an arrangement of crown sheet-bracing, now extensively adopted. Thousands of locomotive boilers similarly constructed are now in use. Should the lesson which ought to be taught by this accident tend to lessen, to the extent of a small percentage only, the existing peril to which so many lives, and so much property is exposed, the information, although obtained at the cost of two lives, and the partial destruction of one locomotive, will, indeed, have been cheaply obtained. Had that boiler been examined after the accident, by any one who was justly alive to, and fully realizing the influence of, the combined action of heat and steam pressure upon such a structure, the evil of forcing extensive and abrupt deflection to surfaces of limited extent, and the rapid deterioration that iron undergoes under such conditions, its malconstruction would have been instantly pointed out, and such an arrangement of bracing, without hesitation, condemned.

As stated above, the absence of flexibility (considered with reference to steam pressure only, promotive, perhaps, of great ability to resist steam pressure) is the most fatally destructive feature that can be associated with steam boilers: this constituted the fatal weakness of this (no doubt), in other respects, strong and well-built boiler.

The system of braces by which the crown bars were braced to the arch-sheet over the fire-box was of that substantial character competent to *control* and *force* the deflections of the arch-sheet into extensive and abrupt deflections along the edges of the two lines of crow-feet on each side of the boiler, along which, on one side of the boiler, under this deteriorating action, the sheet at last gave way.

The whole outline of the break, from the riveted seam to where the broken piece was torn at last from the arch-sheet, presents a clear and convincing illustration of the destructive effect of malconstruction.

Whilst it would be uncharitable to say that such constructions should never have been made, it is manifestly the common-sense aim of inquiries into accidents of such a character, to learn therefrom, as far as possible, the source from whence they spring. We should learn from this accident that the crown-sheet of fire-box boilers should be self-sustaining, viz: its crown bars should have the capacity to sustain the crown-sheet without the aid of braces to any other part of the boiler. Also that vertical braces from the arch-sheet to the fire-box should be avoided; this would leave the inside fire-box and the arched sheet over the fire-box free to take such relative position as temperature and elasticity might require, thus securing for this important part of the boiler flexibility. The expansion and contraction of the arch-sheet over the fire-box would then have been free to distribute itself uniformly throughout its entire surface above the horizontal transverse braces.

In this case, as usual in all such cases, the inquiry before the coroner's inquest was barren of results, no circumstance was noticed by either of the witnesses, or the mechanical experts, warranting any other verdict than: "That the reaction of the internal forces within the boiler upon one another was excited up to a degree beyond the strength of the boiler to withstand, and a rupture became unavoidable."

W. H. THOMPSON.

HORSE-POWER OF STEAM BOILERS.

Editor American Machinist:

Dear Sir:—I have read the remarks upon my article on horse-power of steam boilers, made by Mr. Wm. Golding, of New Orleans, in No. 31, AMERICAN MACHINIST, to which I beg to reply, that the natural effect of evaporation would be as stated by that gentleman, if the steam volume varied inversely as the steam pressure, but as it does not vary in that exact ratio, his calculation is not correct.

In my treatise on "Steam Engineering" are tables for both the natural effect, and legitimate rating of steam boilers by evaporation.

JOHN W. NYSTROM,
1010 Spruce St., Philadelphia.

Editor American Machinist:

Your far-seeing correspondent, Chordal, wants to place his boy Joe on the right road in his mechanical life, and the ground he covers in his letter in No. 31 is well filled.

There are other sides upon which Chordal has not touched, and the most important one is the money question. Few boys have parents willing or able to pay the expense of a college education after the apprenticeship is over, for then the boys are expected to support themselves. Very few Joes will borrow, or, if willing, are able to borrow, the money to defray such expense; and but

few have the chance to earn enough to support themselves while at college. I believe the additional strain on the average Joe who supports himself at college is, to say the least, dangerous to him. Such as have the strength and balance to stand it are certain to succeed in life.

On the other hand, if the college education precedes, that is, at least, paid for, and the mind is trained to think, while it can be moulded. The apprentice earns a regular income, which is a great help to him, representing from $3 to $6 per week. If the college infuses ideas of self-conceit, the parents should, or, eventually, the apprenticeship will, knock them out.

I admit and believe that any Joe who means business can get along, both at college and in the shop, let either precede, but the above considerations should also enter into the problem of how to take care of Joe. I assume that we are discussing the "shop" side of the question, as being the business, mill, factory, or forge. There remains another view to present, that in which the technical and practical are joined. Can some one give a clear view of its benefits?

Yours truly, W. A. LORENZ.

Brooklyn, N. Y., Dec. 8, 1878.

WORK.

It appears the question of horse power of engines will always be asked and the answer correctly given, and still the curiosity to know, or the desire for information on this special subject, will never be satisfied, no matter how often the rule be given.

In Nystrom's Pocket Book of Mechanics, under the head of Dynamics, will be found what may be called the foundation for determining the capacity for work, or, as it is more generally termed, "the power" of anything that moves.

He defines an element as being that which cannot be dissolved into two or more quantities; a function as being the product of two or more different elements; and states that force, motion and time are simple elements. Now, I want to compare these elements to the proverbial "hoss power." First, there is 33,000 pounds; second, to be raised one foot; third, in one minute of time. It is clear the three elements are embodied in it, the 33,000 pounds being the force, the foot being the motion required, and the minute the time. The pounds, foot and minute are only the necessary units of comparison. Multiplying the force which moves a body by its motion, or the distance in the change of its position by the time it was moving, will give the power, or, perhaps, more properly, the work accomplished or required to move the body; but, in order to make the product tangible, it is necessary to weigh the force in pounds, to measure the distance in feet, and to count the minutes of time. Then the product is in foot pounds per minute, and that is all that can be made of it. If the H. P. is required, divide the product by 33,000, which give the H. P. as a unit of comparison, which is the most common one in use. Besides, everybody is supposed to know just what a horse power is. At least, I can't remember of hearing any one ask the question; but the question of "What power is required to drive it?" or "What power is it?" I have often heard, and have sometimes thought that the questioner's real idea of the *power* was but little improved on by knowing the horse power.

Suppose some bright apprentice should insert this quiz in your column of Questions and Answers: "What is usually the average pressure on the piston of a 12" stationary steam engine?" A. "About 30 pounds per inch of the area of the piston." The balance of the figures he has—viz., 400 ft. piston speed, 113.1 square inches of piston area. These, with your 30 pounds pressure, he multiplies together and divides the product by 2000, which gives him the foot tons. He then has as good an idea of the work his engine is doing as any one who assumes the same pressure we did.

"That boy" will never ask for the H. P. of a machine, but, if he wants to know its capacity for work, he will inquire for the speed, or pressure, or both, and, after getting this information, he figures out the H. P. at his leisure. J. H. DUNBAR.

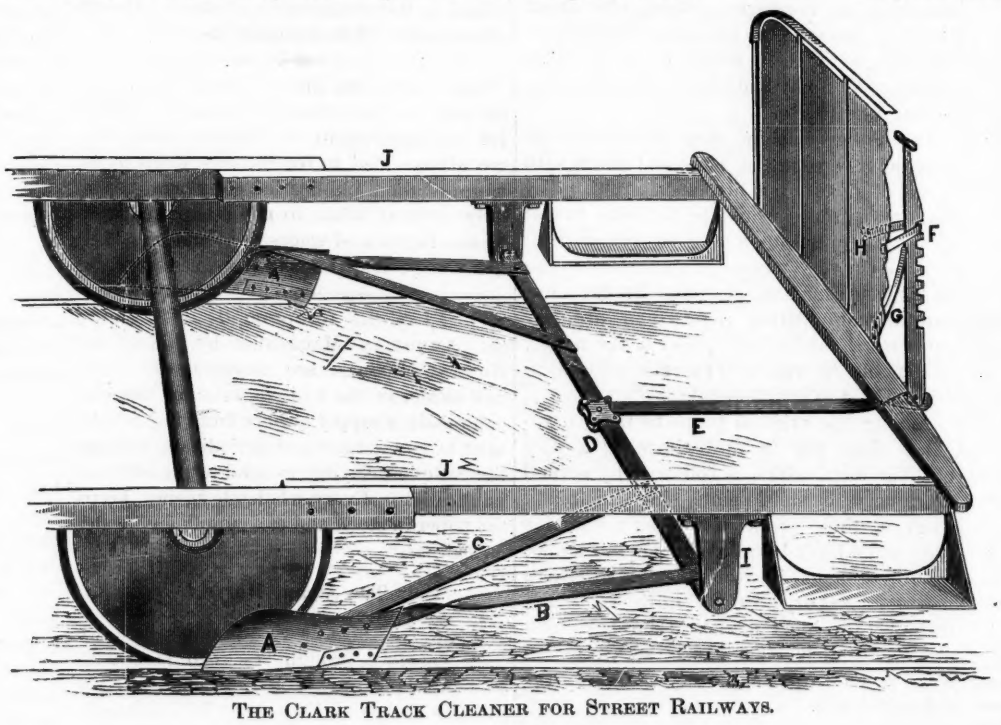
An English "Premium Apprentice."

BY ONE WHO WAS ONE.

I always liked steam engines. My father had a beam engine with parallel motion, jet condenser, cast iron connecting rod, etc., put in his rope-walk, in place of "Gipsey;" "Billy," "Tom," "Boxer," and other fine horses that formerly had swung round the circle to drive the machinery for spinning and twisting ropes. That engine was something remarkable in Wapping, Liverpool, Eng. It was made by Fawcett & Preston, of Liverpool, who, at that time (forty years ago) were known as celebrated engineers. On half-holidays, my greatest pleasure was to go down to the rope-walk and contemplate that engine, besides others in the steamships. I remember the ill-fated *President* well, as my father had furnished her with ropes, chains, oil, tallow, and other ship supplies. At school, I was drawing steam engines in the back of my books, instead of studying to translate Ovid, Euripides and Xenophon. This interest in steam engines and propensity to draw them, regardless of the classics, was reckoned as engineering talent. My father was right and upright in everything I can remember about him, but in this particular he was wrong. I never had any talent, at least, as an engineer; if so, it was buried, never to be resurrected, when he bound me apprentice to owners of very extensive machine works in Leeds. He paid down a large amount of money and the cost of the indenture papers. Party of the first part promised to be a faithful, obedient, industrious, etc., etc., apprentice, not to frequent ale houses, to attend divine service on Sundays, to keep regular hours, and to learn business and craft of a mechanic for a term of five years. Party of the second part promised and agreed to teach said apprentice, in consideration of premium paid, all the mysteries and cunning art of the trade. No wages were to be paid for one year, then five, seven, eight, and ten shillings per week during each successive year. I went to work at six o'clock in the morning, "got docked" if five minutes late; worked in the machine shop until half-past four, P.M., then ran to my lodgings, washed, changed my clothes, swallowed my "tea," and got back to the works by bell time, just half an hour allowed for ablution, changing raiment, eating, and going from and to the works again. And yet I did it. Other two premium apprentices (gentlemen's sons) did the same thing. Here was the daily routine: From six to eight o'clock, A.M., work; from eight to half-past eight, breakfast; from half-past eight to twelve, work; from twelve to one o'clock, dinner; from one o'clock to half-past four o'clock, work; from half-past four to five o'clock, "tea;" from five until seven o'clock, in the drawing office.

So that I was engaged from six A.M. to seven P. M., chipping, filing, drilling, carrying castings and forgings, etc., and drawing. Oh, wasn't I tired! How I did sleep. I had sometimes what would be termed a "rough time of it," placed as I was among uneducated, ignorant, drinking workmen, whose only pride was to be "rare workmen," which many of them were in their specialties. I learned to chip and file and drill, to fit up, to make tracings, and to draw. I got back my indentures when I was twenty-one years of age. Then I worked in other shops at drawing or fitting; went to sea as an engineer, and sought general practice and experience rather than high remuneration. The loved and respected parents, who spent so much money and procured for me so many facilities and opportunities, have long since passed away, *but they had given me*, they said, *what no one could take away from me—a trade.* This is the conclusion of the whole matter. *If you are "bound* to learn" a trade, learn it thoroughly, remembering that whatever is learned in our youth will stay by us better than anything acquired in after years.

The English premium system, as it existed in those days, had its faults as well as its advantages. In this country, we need a system that will encourage employers to take apprentices, and which will also hold out inducements to young men to learn trades, with an assurance that by proper conduct, faithfulness and application, they may possibly excel in their respective vocations.



THE CLARK TRACK CLEANER FOR STREET RAILWAYS.

The Clark Track-Cleaner for Street Railways.

The cleaning of street car tracks in cities by the usual methods is a cause of great vexation and trouble, besides being expensive and inefficient. Many efforts have been made to accomplish this by various attachments to the car with but limited success, many objections being found, until the device we illustrate on this page was constructed and placed upon the market some two years since. It consists of a pair of blades, formed like a ploughshare, attached to arms of spring steel, a direct and diagonal brace being bolted to each blade, and these attached by a clamping device to a wrought-iron rock-shaft, which turns in brackets attached to the sills of the car. A lever leads out from the rock-shaft to the end of the platform, and there is fastened to an upright ratchet, or notched bar, running through a spring catch, by which the blade can instantly, and with one movement of the driver's hand, be lifted from the track, or caused to bear upon the rails with the merest touch, or gradually increased pressure up to a sufficient power to clean ice and similar obstructions from the rails. The machines are very light, weighing from 80 to 90 lbs., and are strong, elastic and durable. Only the very best materials are used in their manufacture, the springs being of the best Siemens-Martin steel and the blades of hard Bessemer. The blades will outlast any ordinary car, or if they should need replacing, in consequence of wear, it can be done at a trifling cost.

Messrs. Geo. C. Tracy & Co., of Cleveland, Ohio, who are manufacturing them, report their sales so great that they are much behind in orders now; but, having perfected machinery for making them, they will be able to fill the largest order hereafter on very short notice. These cleaners are in use in New York City, Providence, R. I., Cleveland, Ohio, Lancaster, Pa., Atlanta, Ga., Montreal and Sarnia, Canada, New Haven, Conn., Boston, Mass., Portland, Me., New Bedford, Mass., Manchester, N. H., Chicago, Ill., Erie, Pa., Pittsburgh, Pa., Milwaukee, Wis., St. Louis, Mo., Brooklyn, N. Y., Easton, Pa., Rochester, N. Y., Kingston, N. Y., Philadelphia, Pa., Williamsburg, N. Y., Davenport, Iowa, and many other places.

The makers have received the statement from one road that the cost of the attachment was saved in one snow storm. It is stated that on 60 pairs used on the East Cleveland road for two winters, there has been no expense for repairs. We have made a number of inquiries as to its operation from parties who have it in use, eliciting the information that it works very satisfactorily, and is a decided improvement over the old plan of track-cleaning commonly in use.

The makers fully warrant them, as well as guaranteeing against claims for infringement. The cut but poorly displays the machine, which is light and tasteful in appearance, and an ornament to any street car. We have every reason to believe it is an almost indispensable assistant to economical and rapid working of street railways. Our readers are referred to the manufacturers for further particulars.

A new invention has been tried with success in London, in the utilization of the power generated in stopping street cars, for the purpose of re-starting them and thus saving the extra exertion of the horses. The contrivance is a coiled spring, which is wound up by the stopping of the car, and which, when released, acts on the wheels, so as to impart motion. It acts, too, as an assistance to horses up a steep grade, the power having been acquired in a preceding down grade, and kept stored in the spring until the energy is required.

It is well to remember in tempering or forging metals, that a piece of cast steel made red and quenched in cold water will become longer, but if the same operation be performed upon a piece of wrought iron it will become shorter.

The pottery manufacturers at their late annual meeting expressed themselves as much pleased at the evidences of the growth of the industry in the United States. Over 30 kilns have been built during the past year, increasing production about 25 per cent., or $1,000,000. The home manufactures are now equal to foreign importations, a point never before reached.

S. N. & C. Russel, woolen goods manufacturers, are building something new in the line of weave-shops in Pittsfield, Mass. The roof is to be of glass, which will be a benefit to the operatives, by having the light overhead, besides enabling them to detect imperfections quicker.

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☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ Subscribers who fail to receive their paper promptly will please notify us at once.

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Minor Economies in Machine Shops.

There are things in machine shop practice—minor economies, we will call them—of much importance, yet which are never brought to general notice. We observed, a few days ago, a box of chalk crayons doing good service in a large shop in Boston. Just inside the door, and in plain view of every workman passing in or out, is a blackboard fastened to the wall. Whenever the proprietor, a superintendent, a foreman, or any of the men desires to explain anything to others that can best be done by aid of a diagram, instead of hunting for a piece of paper and a pencil and going to a bench or shelf to use them, he draws his plan on the blackboard, and the idea is conveyed clearly and quickly to those waiting to receive it. Let not our readers suppose that chalk drawings are used in this shop as guides in the building of machines to the exclusion of regular drafts on paper made upon accurate scales. The blackboard is used as an auxiliary, to give particular instructions, and doubtless saves many annoying cases of misunderstanding, as well as facilitating numerous special jobs of work. It is much to be preferred to a scrap of paper, for the purposes intended, as it does not get lost, nor does it get so dirtied up in passing from hand to hand in the shop as to make its marks illegible. For conveying an idea in the shortest time, where delineations are necessary, nothing else about the shop can take the place of a blackboard. We suggest that it would be a profitable addition to many a machine shop not now having one in use.

In another machine shop we noticed the proprietor working at lathe and bench with a pair of gloves upon his hands. With many the first impulse would be to make fun of this practice, but upon more sober thought it will appear very commendable. Gloves can be worn so as not to interfere with the most careful manipulation required in ordinary shop work, while they preserve the hands, and enable the wearer to exercise boldness in seizing hold of rough metal.

Among the original plans to make a machine shop pay in dull times, is a very peculiar one, which is followed by several machinery establishments in Cincinnati. Each of these proprietors owns a machine shop and a lager beer saloon, having a door opening from one into the other. As often as a machinist gets dry he steps into the beer shop, refreshes the inner man, has another chalk mark (on their blackboard) added to his score and returns to his dry, and, perhaps, arduous labor. At the end of every week the foreman of the machine shop, and the foreman of the beer shop get together, compare tallies and balance every man's account. There is something very systematic about this, but they must follow a system of time-keeping that has not been explained through these columns by any of our correspondents. Something like the following card might prove very convenient.

TIME CARD NO.——

KIND OF WORK.	TIME.	LAGER.
Turning Pulleys.....	3h.15m.	12 schooners
Planing Valve Seats..	1h.30m.	15 ponies.
Chipping Castings...	2h.30m.	11 mugs.

We know but little as to the quality of work they turn out, but are assured upon credible authority that no machinist who lacks *capacity* can hold a situation long in one of these model shops.

There are other Cincinnati machine shops, which, not being educated up to this method of securing a profit, incontinently discharge any man who steps out during working hours to take a drink, and act in just as summary a manner, when a workman brings liquor upon the premises to drink.

Some economical aspects may be discoverd in the extra use of oil in a shop. In one large machinery establishment with which we are acquainted, a rule is in force, that no workman shall wash his hands with oil in the shop. This may seem a trivial matter, but where a good quality of oil is used, and the workmen have a due regard for cleanliness and personal appearance, as is preeminently the case in the shop we have in mind, the quantity used in washing will cause an important item of expense at the end of a year. Even if but a few workmen are employed, the expense will amount to enough to buy a nice Christmas present. Savings of this kind do not indicate niggardliness. A machinist should not only be skillful and industrious but should practice strict economy at his work, in order to command a high grade of pay.

Our esteemed contributor, Mr. Wm. J. Williams, whose articles, as they originally appeared in the AMERICAN MACHINIST, have made his name familiar to a great number of the readers of mechanical literature, having been widely copied, not only by the press of this country, but also of Europe, has recently accepted the position of Chief Engineer of J. B. Moorhead & Co's extensive blast furnaces, at East Conshohocken, Pa. We congratulate this firm on securing the services of so able an engineer. We expect our readers will, as heretofore, have the pleasure of perusing an occasional article from his pen, one of which appears in this issue.

We would direct particular attention to "An Easy Method of Calculating the Loss in Long Steam Connections," by Wm. Main, which appears in this issue. This is a very seasonable subject, and we would be obliged to our readers for statements of results obtained in the transmission of steam through pipes under different conditions.

Our thanks are due to many of our readers who send us occasional items of interest for our department of Manufactures. We are always glad to receive such items in advance of their publication elsewhere, especially such as relate to new shops, enlargements, increase of wages, new and improved machinery, and changes of management.

Our facilities for promptly distributing the AMERICAN MACHINIST by aid of the News Companies are unsurpassed. Any newsdealer in the United States, or Canada, can obtain a supply at once from any wholesaler of newspapers and periodicals, without the latter's delaying to send to the office of publication. Every wholesale agency keeps the paper in stock and can supply any dealer on call.

The Steam Horse.

Every few days, in this practical age, we find ourselves brought face to face with some new and unexpected fact, and our pet theories and traditions must be constantly trimmed to correspond.

The latest illustration of this tendency is the steam engine. Everybody who has read anything of its history knows that the Marquis of Worcester has been credited with being one of the earliest inventors who successfully dabbled with steam. But a fact has recently come to the surface which tends to discredit this theory. In the light of this fact no intelligent person, who is familiar with the part played by the noble Marquis in founding the thriving Massachusetts city which bears his name, can longer attribute the steam engine to his authorship.

Then, too, we have all heard of Watt's connection with the further growth of the steam engine, and, notably, with the application of the indicator as a means of determining its horse power. So far, nothing has come to light which throws doubt upon his authorship of the hymn:

"How doth the little busy bee," &c.,

and the other sacred songs which bear his name, but, with reference to the steam engine, we must hereafter be compelled to doubt. As to the horse power question, the present revelation rather tends to strengthen his claim than otherwise.

Referring to the history of the locomotive as a department of the steam engine, we have heard a great deal said of Stephenson as its reputed inventor. Most of us have ridden in Mr. Stephenson's horse cars, but, in the face of the true theory of the origin and growth of the locomotive, as now developed, we must, at least, preserve a judicious silence for the future.

Elsewhere, in the pictorial portion of this paper, we reproduce an engraving from a late issue of one of our exchanges, which, to the thoughtful mind, overturns most of the existing theories upon this subject, and supplies the missing link which connects the locomotive and steam engines of the present day with the animal kingdom in which they took their rise. The doctrine of evolution, with which we have been made familiar during the past few years, has nowhere received a more thoroughly practical illlustration than we find in the "Novel Traction Engine" described. No enthusiastic student of this theory, in examining the movements of this developed animal, can fail to see that it stands midway between the ordinary equine horse and the modern engine. By what process of evolution the peaceful tail of the horse grew into the additional leg and foot shown in the engraving, we are only able to conjecture. The assumption is, however, that when the tail was no longer required for the purpose of brushing away flies, owing to the gradual change of horse-flesh into metal, Nature, which does nothing in vain, set all her forces to work to utilize this appendage, and the additional leg is the result.

As to the manner in which this curious specimen came to light, just at this time, we are bound to credit the authoritative statement that it is a recent invention, although appearances point decidedly in another direction. When George Washington first patented and built his famous monument at the national capital, certain curious relics of antiquity were placed underneath the structure, as is the custom on such occasions, and it may be that recent excavations therein have furnished the clue to this startling mystery.

We are pleased to learn that Mr. M. Diamond, formerly of Hartford, Conn., has accepted a position with the John Stephenson Co., the well-known street car building establishment of this city.

The tests which were to have been conducted by the Buckeye Engine Co., at the fair of the American Institute, have been temporarily abandoned. They had prepared a comprehensive programme to demonstrate many points of engineering, and no labor nor expense was spared to bring about valuable and reliable results. It proved to be impossible to get the required load (125 horse-power) with sufficient uniformity by any means at command, or without the use of water on the brake surfaces to a degree which inconvenienced the other exhibitors and the visitors. The Company are now arranging with a large mill where all the requirements can be met, and will shortly prosecute their experiments in full, due notice of which will be given.

In this issue, "Chordal" unbosoms himself upon the subject of Accessories to the Indicator, as promised in last week's "Extracts." This topic which is equally important to steam users, engine builders and engineers, is illustrated with twelve original engravings.

This week the foreman of a large Western shop in sending us a long list of subscribers, taken in their works, says:

"Every man in the shop wants to read your paper; will send you another list after next pay day."

In another letter, the proprietor of a Western shop, writes:

"Every man in our shop reads the paper; it has made quite a revolution in shop work."

With this issue, Vol. II of the AMERICAN MACHINIST closes. On pages 11 and 12 will be found a complete Index to this volume, covering all the topics treated upon during the year. Seven monthly and twenty-six weekly issues presented during the volume now closing, if preserved in a Monitor Binder, or in regular book form, cannot fail to prove a valuable addition to any practical man's library.

The last issue of the *Paper Trade Journal* cribs entire, the valuable article, written for the columns of the AMERICAN MACHINIST by Park Benjamin, Ph. D., entitled, "Concerning Trade Literature," which appeared in our issue of November 29, 1879, and reproduces it conspicuously without a stitch of credit. If the editor of the *P. T. J.* will step round to our office, we have some original matter which has not been used, that we can accommodate him with, thus saving him some wear and tear of conscience.

The substantial character of the circulation of a newspaper can largely be determined by examining the character of its advertisements. In concluding our second volume, we invite criticism upon the AMERICAN MACHINIST in this respect. The advertising department of a technical journal, especially, should be a fit companion to its reading columns, and should be the means of suggesting valuable ideas.

Machinery Accidents.

The number of distressing accidents occurring lately by reason of exposed belts and shafts, in establishments using machinery, calls for extended reform in this direction. Items in the daily papers about workmen being caught up by driving belts or shafts, and crushed in the machinery, are becoming alarmingly frequent, and suggest the idea that when business is brisk in manufacturing establishments precautions for safety are almost ignored. Driving belts and shafting, where exposed, and likely to come into contact with individuals required to pass near them, should be *boxed* or covered in some way, so as to prevent the likelihood of accident. Elevators, too, have proved very treacherous of late, showing that increased care is required in designing and constructing these useful contrivances.

Many accidents are attributable, at times, to carelessness of workmen, as, for instance, getting fingers chewed up in lathes, pounding off thumb nails, and falling through open hatchways, but the prime cause of the most serious mishaps too often may be found in defective arrangements. We commend this subject to careful consideration.

LITERARY NOTES.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E. 1 vol. octavo, 230 pages, neatly bound in cloth; price, $3. Published by D. Appleton & Co., 549 and 551 Broadway, N. Y.

The first part of this book was originally published in pamphlet form, for private distribution among the New England cotton manufacturers, the edition being limited to 500 copies. But the growing demand for a book which would embody reliable tests of the different classes of machinery used in cotton manufacture, finally induced the author of this work to publish the original pamphlet with the addition of many recent tests which had never before appeared in print. It is now available to the public under the above title, and will doubtless be found of general interest among manufacturers. Mr. Webber has given his time principally, for many years, to the testing of cotton machinery. The first part of this book gives the result of tests made in order to ascertain the actual power required to drive cotton spinning machinery up to the required speed. It should be stated here that machinery upon which tests are to be made should be run long enough to allow the bearings to get into good condition, as neither very new, nor very old machinery can be relied upon for a test. In the former case, there is a loss from the extra friction, while in the latter a loss results from extra gyration. The first tables contain tests made from 1871 to 1874, and the second part those from 1874 to 1879. These tables are reliable, and will be found very practical. Then follows the record of some tests on the strength and velocity of shafting, compiled from long and careful experiments, together with tables for easy reference. The author also publishes a summary of the results of the tests made by the best authorities on belting, with horse power and other particulars. The water-wheel tests are among the most interesting features of the book, as they contain corrected tables of the Centennial tests. The actual power of turbine water-wheels heretofore has been very obscure, and for reliability there is probably no one better capable of writing up the power of water-wheels than Mr. Webber, having superintended the Centennial trials of water-wheels, besides having charge of many other tests, both before and since.

The apparatus used in all these trials is fully explained, which greatly adds to the interest of the work. The tables given are worthy of careful study, and contain much practical information. There are a large number of tables for roving and twisting yarn, which are accompanied by simple and plain rules for computing the power required to drive the different machines and their parts.

We are glad to notice that these rules are in plain figures, and the higher mathematics have been carefully avoided, which is a great benefit to the average mechanic.

The latter part of the book is devoted to a historical sketch of the commencement and progress of the cotton manufacture in the United States up to 1876, with statistics comparing the manufactures of different countries, number of spindles now running, etc.

The history of the different processes in the cotton manufacture, inventions of machinery, etc., makes this book a valuable work of reference.

A brief biography is also given of some of the principal inventors.

The rapidity of the growth of the cotton manufacture forms one of the most prominent examples of American enterprise, which has never, to our knowledge, been published in a reliable shape until the appearance of this book.

A supplementary chapter and index contains a great deal of valuable matter in reference to the exhibit of machinery and fabrics at the Centennial. We desire to mention one table, in particular, contained in this work, which relates to the power required to drive miscellaneous machinery and tools, such as lathes, planers, milling machines, and other machines of this kind, as commonly found in a machine shop.

The work bears evidence of being complete, and, as a whole, like an egg "full of meat," and will doubtless be highly appreciated by mechanics in general.

The American Bookseller for Christmas, published by the American News Co., New York, is before us. It is a finely printed, and profusely illustrated volume of 162 pages, and gives information of all the latest and best books for the holidays.

To those desiring to make choice selections, it is the best guide we have seen.

Notes of the Press.

(*From the New York Tribune.*)

The AMERICAN MACHINIST is publishing a valuable series of articles under the title of "Letters from Practical Men."

(*From the Akron City Times.*)

The AMERICAN MACHINIST is the best paper for practical engineers and machinists published in the United States. This is the verdict given by several of the best machinists in Akron.

(*From the National Car Builder.*)

The AMERICAN MACHINIST has recently entered upon the third year of its publication, having commenced as a monthly, and after a period of vigorous growth was changed to a weekly. It occupies a field which it has made peculiarly its own, the nature of which is indicated by its title. As a guide and manual for practical machinists, engineers, inventors, and all who are interested in the construction and management of machinery, it is one of the most useful publications of its class. Its remarkable success has been attained by diligent and well directed effort, and a thorough appreciation of the wants of mechanics and artisans, as well as dealers in tools and mechanical appliances. Whatever topic is discussed, editorially or otherwise, is handled with an evident knowledge and discrimination that wins the confidence of the reader, and assures him that he is not being misled or deceived. It is one of the best of our technical journals, and should be in the hands of every mechanic, and especially such as have any thing to do with steam mechanism. The engraved illustrations are numerous and appropriate, the typography unexceptional, and the general make-up attractive. Its contributors embrace a large number of well known writers upon mechanical topics, and the editorial articles are clear, concise, well written, and instructive. There are 16 four-column pages. Price $3.00 a year.

(*From the Peoria Sun.*)

The AMERICAN MACHINIST.—The third volume of this periodical commenced on the 15th of November. It is preeminently a practical journal of mechanics and mechanical science, filled every week with information of interest and value to every mechanic. "Chordal's" Letters are alone worth the price of subscription to every machinist, whether employer or employee, while the other matter is such, that no man who either makes, sells or uses machinery or mechanics' tools can well afford to be without it.

(*From the Vindicator, Lynn, Mass.*)

All interested in mechanism, as well as others, will find the AMERICAN MACHINIST of especial interest, filled as it is with important and valuable information.

One of our subscribers sends us a copy of the *Sunday Morning Bazoo* published at Sedalia, Mo., a thriving railroad town. The paper contains the following, indorsed in pencil: "The Western boys are blowing for the AMERICAN MACHINIST:"

TO RAILROAD MEN—WANTED.

Wanted, machinists and blacksmiths by the hundreds; also locomotive engineers and those who expect to become runners, and machinists of every other trade, to go to McClellan Bros. book store, Second street, next door to the post office, and ask for the *American Machinist* of November 15, 1879, and read "Railroading Emergencies," or "How to work a broken down locomotive into the shop by her own power," by V. Hook. It will be found on the fifth page, and will interest many an old runner, and much more those who are just learning. If McClellan Bros. have not got it, get them to send for it, or send for it yourself. Price only six cents. Mail two three cent postage stamps to the American Machinist Publishing Company, No. 96 Fulton street, New York City. Every machinist in Sedalia ought to become a subscriber to this instructive weekly paper, as it ever goes right into the shop and there tells you just how work of all classes is done by experienced workmen. Its question and answer column is worth more than the subscription price. Get a copy for yourself.

Business Specials.

Forty cents a line for each insertion under this head.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

The Huntoon Steam Governor Co., of Lawrence, Mass., warrant a direct saving in steam of from 10 to 20 per cent. over any other Governor known; while for quick and accurate regulation, great durability and lasting economy in use, they guarantee results never before attained by any other. See advertisement.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, Piermont, N. Y.

Large stock of new and second-hand Horizontal and Vertical Engines and Boilers. Send for particulars, stating power and style required. Belcher & Bagnall, 40 Cortlandt St., New York.

Tool Chests with best tools, scroll saws, wood and designs. Amateurs' and Machinists' Tools. Send for Catalogue. Tallman & McFadden, Philadelphia.

Steel Stamping Figures and Dies.—1-16" to 1-8" Figures, per set, $1.00; 1-8" Letters, $3.00. American Tool Co., Cleveland, O.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1.) W. J. D., Canton, O., writes: Would you please give me, through the columns of your valuable paper, the rule for proportioning the diameter of flues and tubes to suit the diameter of shell of boiler? *A.*—The *total* tube area of boilers must not be less than one-eighth (⅛), and not *more* than one-fifth (1-5th) the total grate surface of boiler; grate surface with natural draught from 32 to 34 to 1 compared with heating surface. Experiments made by W. H. Hoffman, with fifteen (15) different boilers, showed that the total tube area gave the best evaporation when sub-divided fifty-four (54) times, the tubes being forty-eight (48) diameters long, and the shells all being above 42" in diameter, the largest being 66" diameter. Now, as tubes less than 2½" in diameter are entirely useless with natural draught, shells under 42" should not and really cannot, with any economy, be sub-divided more than thirty-six (36) times; and thirty (30) divisions on a 36" shell will give within a fraction the same evaporation as a 3½" tube in a 66" shell, provided the 2½" is no more than forty-eight (48) diameters long. There are no text books that give the proportions asked for.

(2) H. S. R., Union Springs, N. Y., writes: Will you please inform me through your columns where I can obtain the best treatise on the following subjects: Locomotive Construction and Running; Marine Engine Building; Steam Yacht Building (Propellers)? *A.*—Forney's Catechism of the Locomotive, $2.50; Edwards' Catechism of the Marine Engine, $2; Treatise on Model Yachts, Ships, Steamers, etc., by T. E. Biddle, $2.

(3) What wages are apprentices to the machinist trade generally paid the second year? *A.*—In railroad shops apprentices generally receive $1 a day the first year, $1.25 the second, and $1.50 the third. For wages paid apprentices in a number of other machine shops see AMERICAN MACHINIST, Aug. 16th, Sep. 27th, Oct. 25th, Nov. 1st, and those of earlier dates.

(4) W. F. H., Newark, N. J., asks: What is the proper distance between a fire-grate and boiler, the ordinary horizontal flue type. *A.*—From 10 to 12 inches.

(5) J.C. S., Union, N.Y., asks: 1. At what speed ought a tool to run to mill cone points on wire from No. 12 to 5, at the rate of 75 per minute? *A.*—About 400 revolutions per minute. 2. Give me a rule to find out the size and pitch of miter bevel wheel gears, the H. P. being unknown. *A.*—The H. P., or strain upon the tooth is just what you must know before you can calculate the pitch.

(6) I. S. T., Bedford street, N. Y., asks: If the "pop valve" used on the locomotive Lehigh, that exploded on the D., L. and W. R. R., and was noticed in the AMERICAN MACHINIST of Dec. 6th, 1879, is the same used on locomotives 25 years ago? *A.*—The valves in use on locomotives 25 years ago were known simply by the name of safety valves, some of which approximated to some of the valves in use at present. Pop valves, as at present used on locomotives, are made under different patents. The general idea seems to be to increase largely the opening of the valve at the pressure of blowing off. This is accomplished by several devices, which all tend to the same result—namely, lifting the valve, by the pressure of the steam in the boiler, higher than can be done by the old arrangement of safety valves, thereby giving quick relief, and a large opening for the escape of the steam from the boiler. The general principles of the pop valve are shown in our issue of Dec. 13th, 1879, page 7. It might be necessary to state that, in the place of the jacket used in the cut, a pair of studs are screwed into the boiler and a cross bar is placed across the top as a support for the spring. The pop valve, as now in general use on locomotives, which was introduced about 1866, took its name from the fact that, when the pressure in the boiler rises high enough to raise the valve, the steam will act upon a lip or projection (shown in the number of our paper referred to) and raise the valve still higher from the seat, thereby relieving the pressure in the boiler at once, and, when thus relieved, the valve will close tight. The same operation will be repeated as often as the pressure rises to the blowing-off point. The noise made by the escaping steam resembles a sudden explosion of "pop," from which it takes its name. The pop valve on the locomotive Lehigh, of the M. & E. R. R. is known as the Dawson valve, which differs from others in this way: instead of a single round hole and a single seat, there is a circular opening, about 5-16 in. in width, with a seat for the valve on each edge of the hole. Thus the valve has a double seat, and, when the valve is raised from its seat, steam escapes through the center of the valve, as well as the outside. The claim of the inventor is that it allows double the space for the escape of the steam. The spring and studs used with this valve are like those of the ordinary pop valve.

MANUFACTURES.

Wm. Allen & Sons, Worcester, Mass., write us: "The Victor Heater is meeting with success, and we are crowded to our capacity with orders, so much so that it has been impossible for us to fill promptly. We have the first prize from the Cincinnati Industrial Exposition, and the inclosed letters [several very flattering letters inclosed] will show its work where we have put them in. We shall increase our facilities for turning the heaters out so as to fill orders promptly. Since ordering a *second* heater, Mr. C. L. Hawes, of Dayton, Ohio, has again ordered one of the same size to be put in a new mill with the Buckeye engine, new boilers, etc. From this, you will judge of our success with the heater.

A correspondent in Fall River, Mass., writes us as follows:

Fully one half the cotton mills in Fall River are now paying weekly, and it is probable that all of them will at no distant day. The companies keep back from six to ten days' pay to insure the return of their help after pay-day. The Union Cotton Mill No. 3, of Fall River, which was partly furnished with machinery when the defalcations of its late treasurer were discovered, commenced operations last week, and a large force of men are now engaged in placing the rest of the new machinery; when this mill is complete, the company will run eighty-five thousand (85,000) spindles. All the mills on the stream are partly shut down on account of low water, this is very unfortunate with the present state of the market. The mills here employ fifteen thousand help, and on Nov. 26th, the Board of Trade (manufacturers) voted them an advance of 15 per cent. in wages, to take effect Jan. 1st, 1880. Good news for our merchants as well as the help. The American Print Works will soon shut down indefinitely, or until the creditors who take it at twenty-five cents on the dollar can see money in running it.

Another improvement at Holyoke, Mass. was begun Saturday week in the extension of the Springfield Blanket Co.'s works, which will make them the largest establishment of the kind in the country. One building will be 27x45 feet, and another 65x45 feet. Ten sets of woolen machinery will be put in.

Lyons, N. Y., is soon to have an edge tool manufactory, employing from thirty to forty men.

Quite a number of enterprising business firms have purchased land on the east side of Cooper's Creek, N. J., from Capt. E. D. French, and a number of manufacturing industries will shortly be commenced.

D. & W. Pemble, Stillwater, N. Y., are rebuilding their straw-board mill without stopping work, having erected a substantial brick structure directly inclosing their old mill.

F. Haberman, Pearl St., New York, is about to erect a five-story brick factory for tin ware, at North Second and Fourth Sts., Brooklyn, N. Y. It is to be 50×178 feet. A blacksmith shop and boiler house will also be erected 25×112 feet.

Buchanan & Lyall are about to erect a four-story brick factory 180×180 feet, on Carroll St., near Bond, Brooklyn, N. Y., also a two-story brick carpenter shop, 63×28 ft.

The Phœnix Chemical Works are soon to build a 57×150 feet two-story brick factory, on Second Avenue and Thirty-Ninth Street, Brooklyn, N. Y.

The city of Maysville, Ky., is soon to vote on the question of water works. Mr. Daniels and other gentlemen from Louisville have submitted proposals, 135,000 to 150,000 being the figures named.

Jacob Reese, of Pittsburgh, Penn., is negotiating for a site for a hoe factory in Monongahela City, to have a capacity of 1,200 dozen hoes per day.

Machinists' and Engineers' Supplies.

NEW YORK, Dec. 11, 1879.

The changes this week are small potatoes, and few in a hill. Business good and prices steady.

Wrought and sheet brass are being advanced today, manufacturers being now in session.

Chucks are said to be unreasonably low and likely to advance in price.

Girard wrenches have made a small advance.

Morgan & Herrick, 86 John St., New York, have just taken the agency for a new patent Chain Link, made by the Ingalls Mf'g. Co., Providence, which is very cheap, compared to other appliances for the purpose.

Wm. Cooke, 6 Cortlandt St., New York, has just taken the agency for the Waters' Governor.

Iron Review.

NEW YORK, Dec. 11, 1879.

While there is no change in quotations since our last, we have to report that the market has stiffened, both at home and abroad, within the last ten days, and the feeling is becoming general, and the opinion is expressed largely that there will be no reduction, but, on the contrary, prices will rule higher than the present in the spring.

Pierson & Co., 24 Broadway, New York, quote Boiler Makers' supplies out of store: Tank Iron, 4½c.; C. No. 1 Boiler Plate, 4¾c.; C. H. No. 1 ditto, 5c.; Best Flange ditto, 6c.; Boiler Rivets, 5 to 6c.

Other Iron Supplies out of store:

No. IX Pig, $30 to $31 per ton; Iron Rails, $50 to $60, according to weight; Old Rails, $31.50 to $32; Fish Plates, 3c. per lb.; Railway Spikes, 3¾c.; Bolts and Nuts, 4½c.; Common Bar Iron, 3c., basis from store; Refined, 3 2-10c., basis; Ulster, 3 8-10c., basis; Machinery Steel, 7c.; Best Tool Steel, 12½c.; Norway Bar Iron, 5½c.; Norway Shapes, 6c.; Nail Rods, 6 to 6½c.; Sheet Iron, 4½c., basis; Angle Iron, 4c.; Tee Iron, 4½c; Band Iron, 3 6-10c.; Hoop Iron, 3 8-10c.; Horse Shoe Iron, 3 8-10c.; Hot Polished Shafting in lengths, 2 ft. and longer, 7 to 8c., according to size; Small Black Rivets, 50% off in papers, 35% off in bulk.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of Dec. 11th, 1879:

The demand for Metals is remarkably good for this portion of year. Markets steady. London Cable Pig Tin (Straits) £92.10/. We quote spot prices: Banca Tin, 24c.; Malacca and Straits, 21½c. to 22c.; Billiton 21½c.; Australian—nominal — 21¼c.; "Lamb and Flag," 21c.; Pig Lead 5¾c., reported higher in Europe; Antimony, 17c., ordinary brands; Cookson, nominal, 20c.; Spelter, firm in Europe, but dull here; Silesian, 6¼c.; Domestic, 6¼c.; Ingot Copper, 21¾c. to 21¾c.; Nickel, $1.25 to $1.50; Bismuth, $2.50; Solder, No. 1, 11¾c.; "Half-and-half," 13¾c.

Situations Wanted—Help Wanted.

We will publish notices suitable for the above headings, applying to any of the machinery trades, and not to exceed four lines each (32 words), at the nominal rate of twenty-five cents for each insertion.

Manufacturers requiring the service of a Mechanical Engineer and Draughtsman, who can take the lead in designing and constructing first-class Steam Engines and Mill work, will please address A. P., AMERICAN MACHINIST, 96 Fulton Street, New York.

A reliable machine shop superintendent, also a good draughtsman and pattern maker, may be found by addressing Prof. John E. Sweet, 11 Elbridge Street, Syracuse, N. Y.

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Counselors at Patent Law
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Before doing anything in regard to Patents, send for our 140 page book, "ALL ABOUT PATENTS," mailed free.

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ENGINEERS, MECHANICS, Mill Owners, Miners, Merchants, &c., will find in Moore's "Universal Assistant & Complete Mechanic," a work containing 1016 pages, 500 Engravings, 461 Tables, and over 1,000,000 Industrial Facts, Calculations, Processes, Secrets, Rules, &c., of rare utility in 200 Trades. A $5 book free by mail for $2.50, worth its weight in gold to any Mechanic, Farmer, or Business Man. *Agents Wanted.* One Agent reports 41 sales in 2 days; another 29 sales in ¾ day; another 27 sales in 2 hours. For Ill. Pamphlet send stamp to R. Moore, No. 20 Cooper Inst., N. Y.

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THE BEST IN USE.

In successful operation on OVER THIRTY RAILWAY LINES.
Prices very low and quality guaranteed. Send for Circulars, our new Price List for November, etc.
We refer to East Cleveland R. R. Co., Cleveland, O.; Coney Island & Brooklyn, N. Y.; Fair Haven & Westville, New Haven, Ct.; Erie City R. R., Erie, Pa.; Sarnia R. R., Sarnia, Ont.; Manchester Horse R. R., Manchester, N. H.; Broadway & Centreville, New Haven, Ct.; New Bedford & Fairhaven, New Bedford, Mass.; Lancaster & Millersville, Lancaster, Pa., and many others which limited space prevents mention of. The orders received thus far this season aggregate some fifteen additional railways.
We send Cleaner on trial, subject to severe test, and invite correspondence.
GEO. C. TRACY & CO., Manufacturers, CLEVELAND, O.
AGENTS:—Lovegrove & Co., 152 N. Third St., Philadelphia, Pa.; Stephen Tracy, New England Agent, New Haven, Ct.; Henry S. Patten, 149 Broadway, N. Y.; J. B. Williams, 60 Franklin St., Baltimore, Md.

For Illustrated Description, see Page 7 of this Paper.

PP 11, 12 are ad pages

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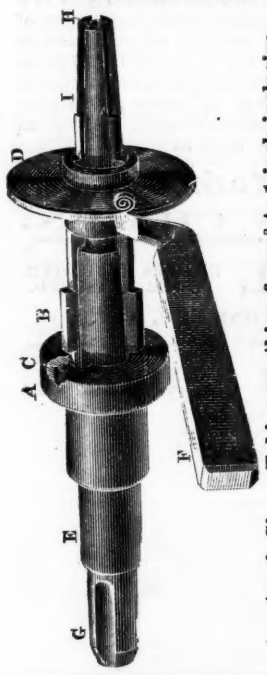

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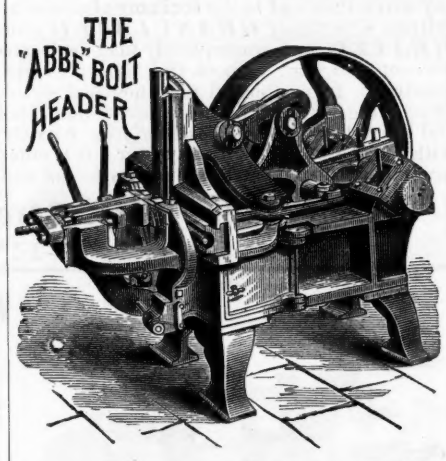

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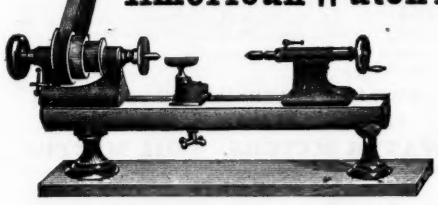

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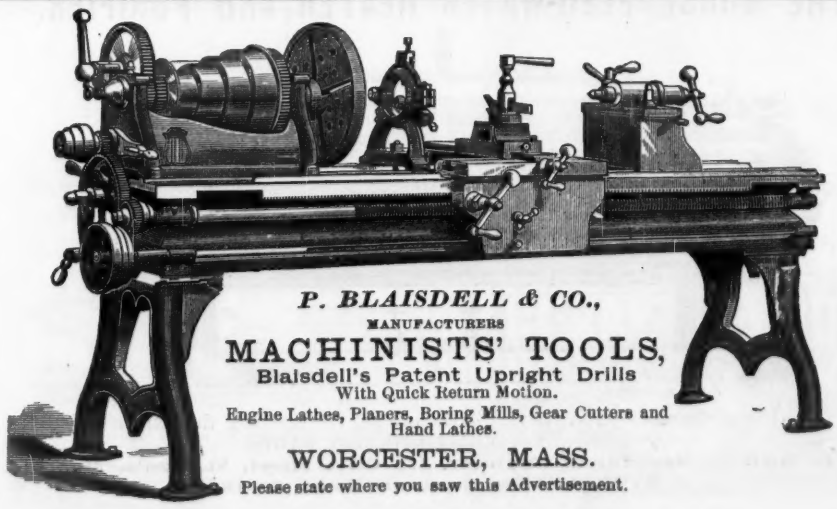

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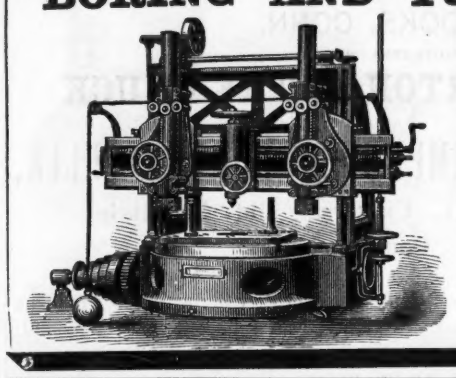

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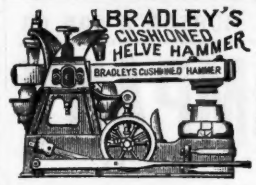

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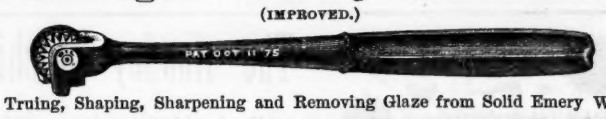

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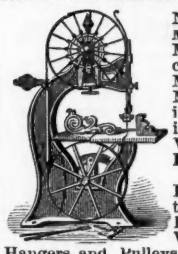

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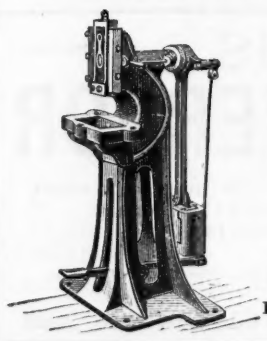

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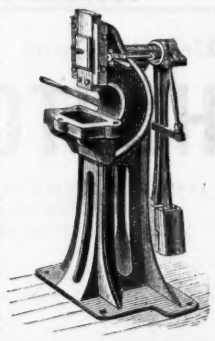

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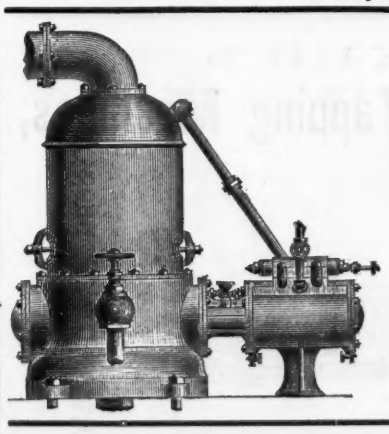

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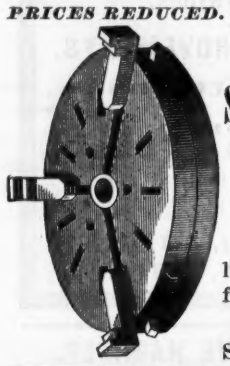

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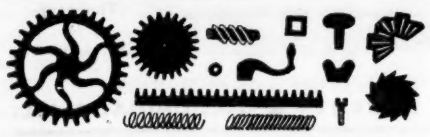

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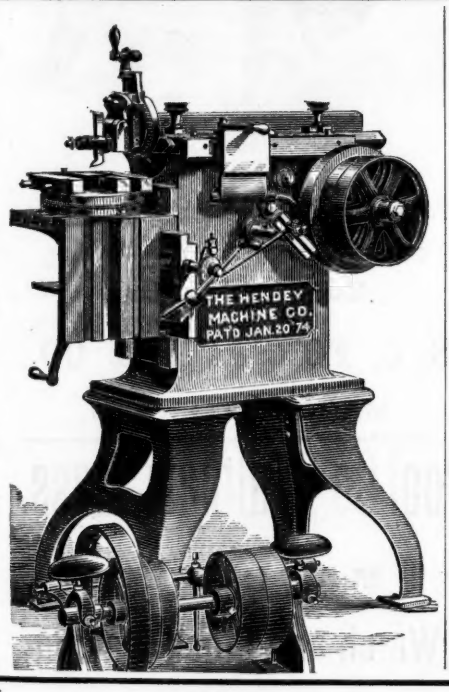

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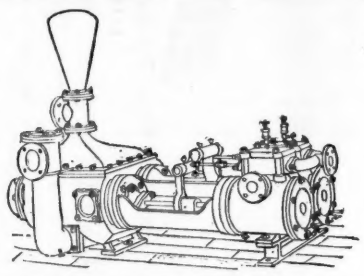

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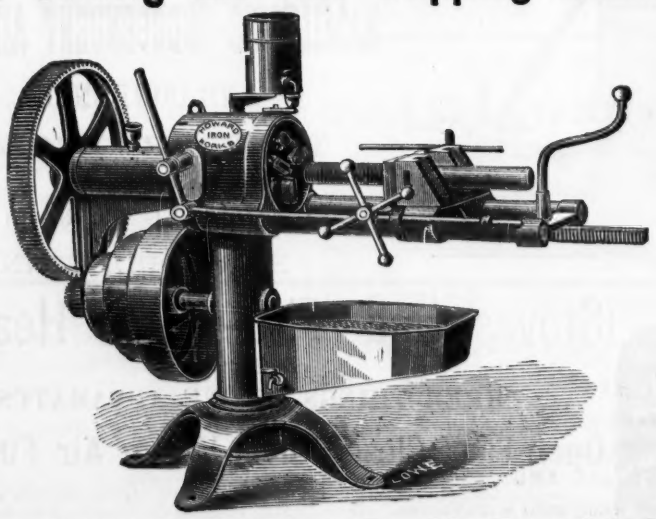

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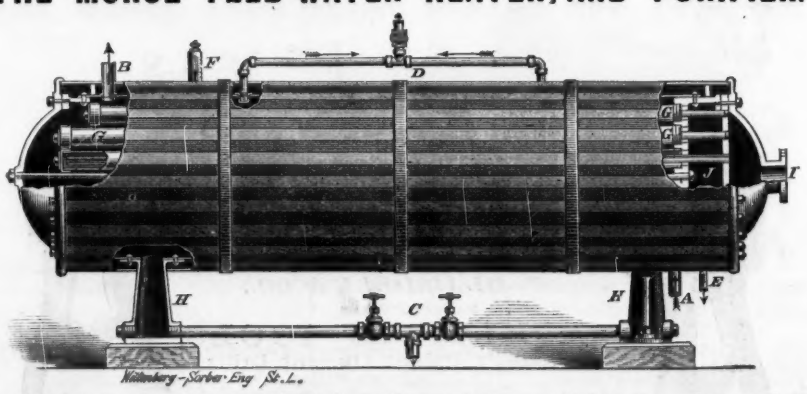

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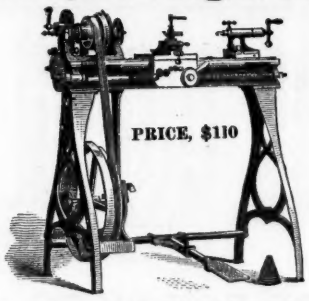

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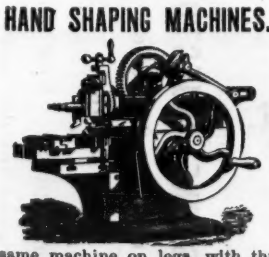

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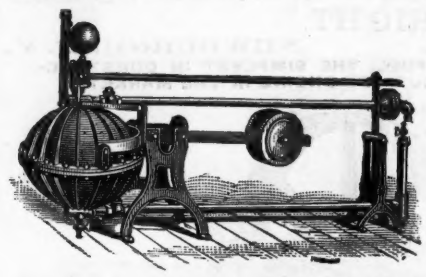

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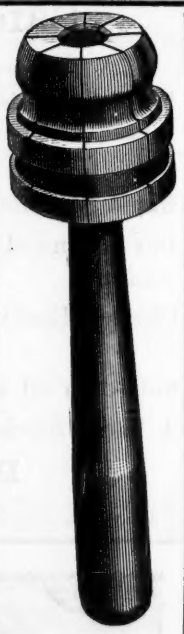

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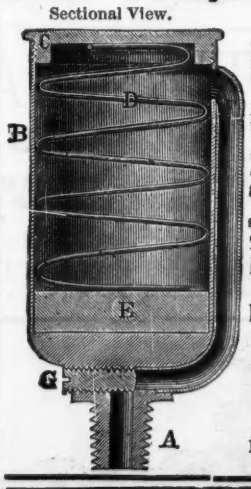

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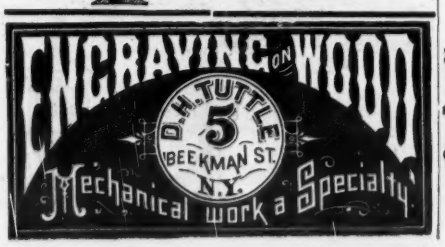

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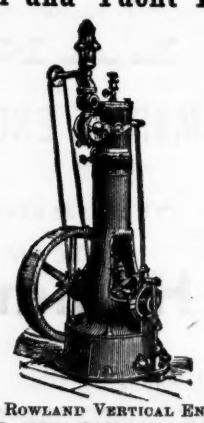

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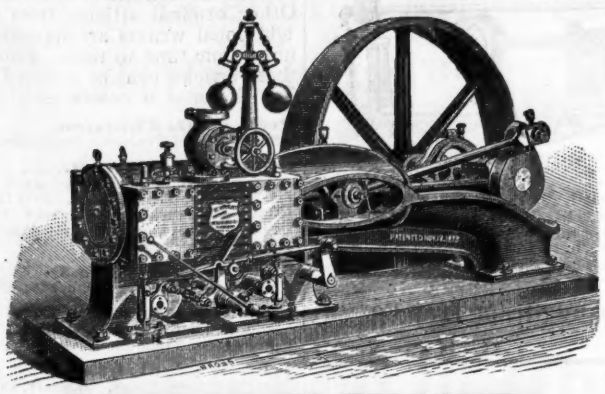

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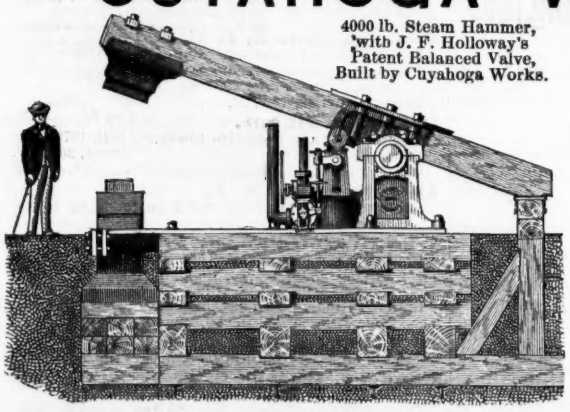

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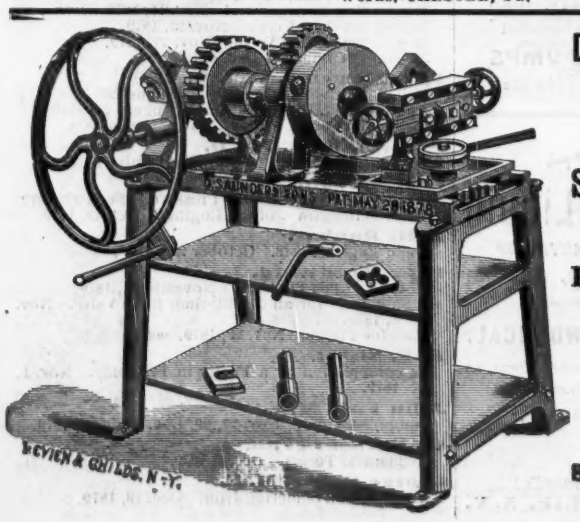

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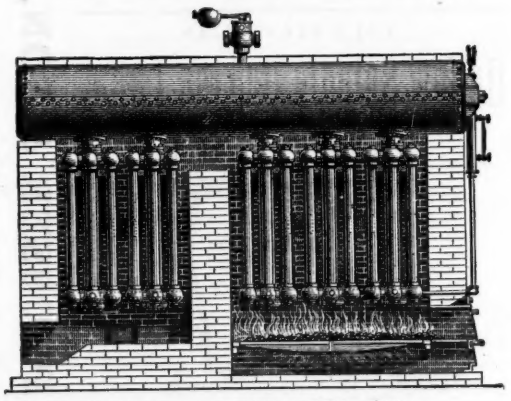

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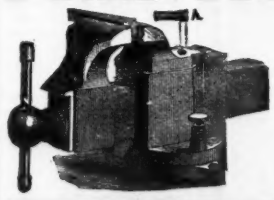

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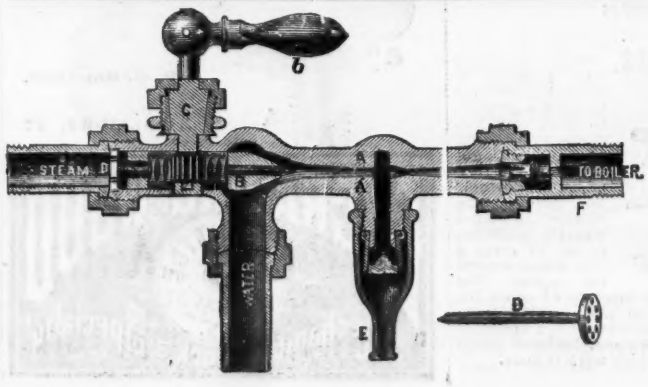

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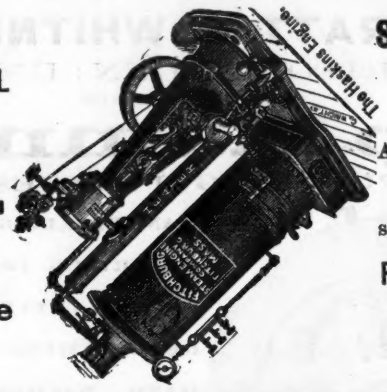

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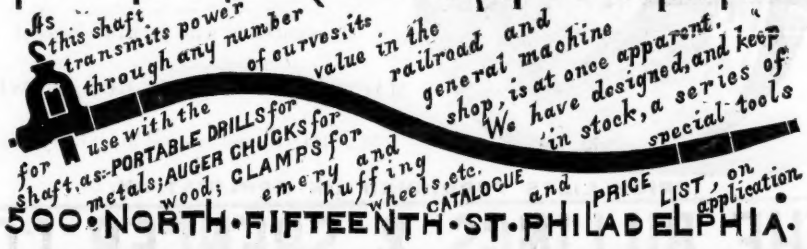
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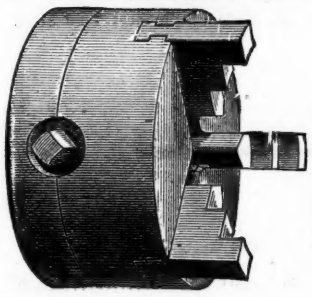

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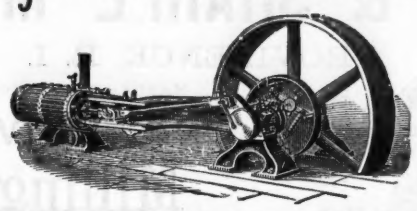

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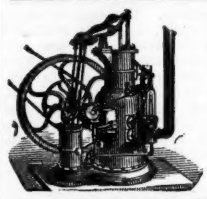

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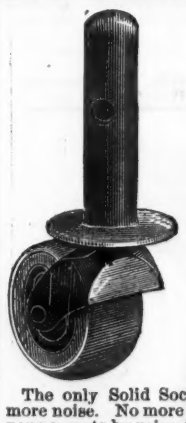

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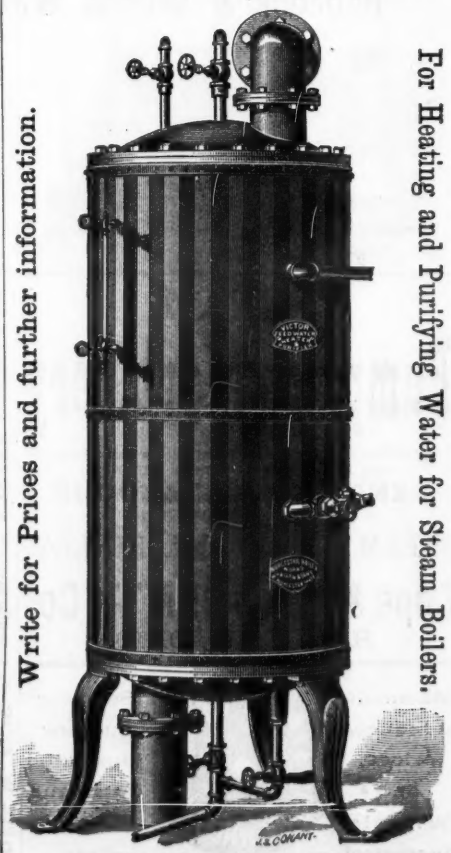

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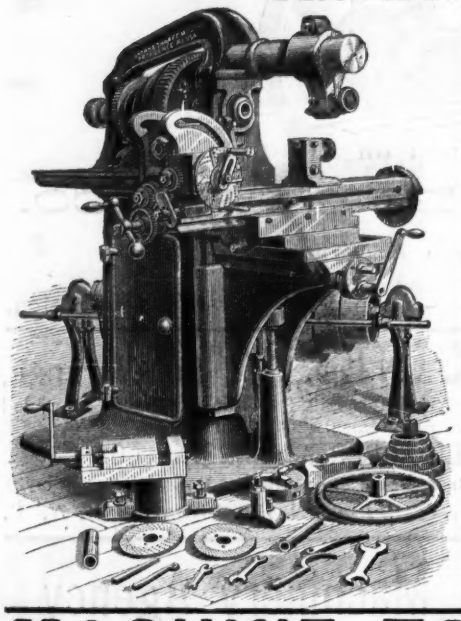

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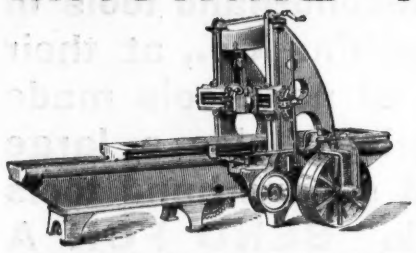

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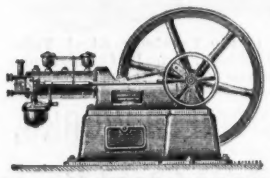

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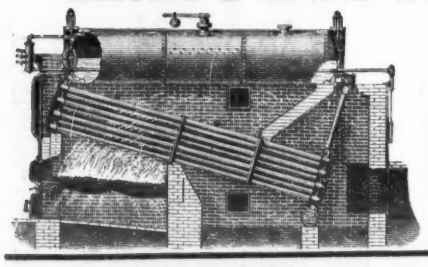

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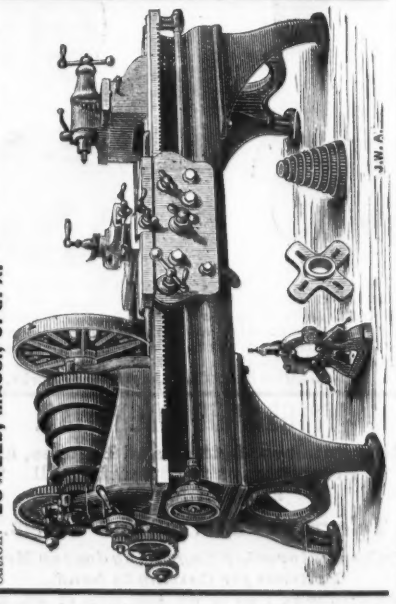

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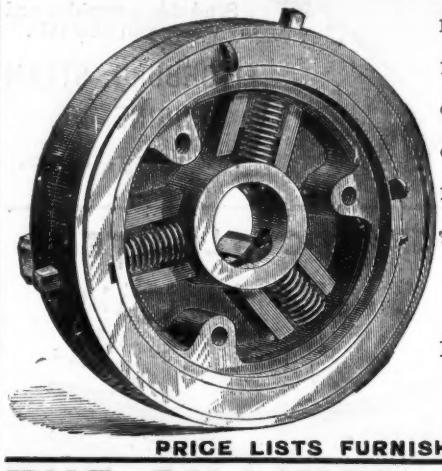

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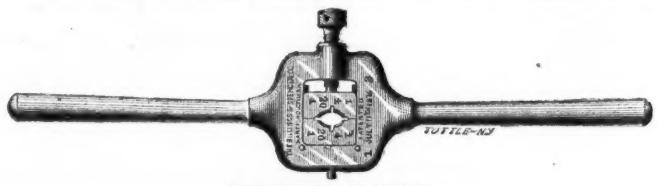

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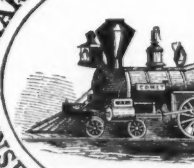

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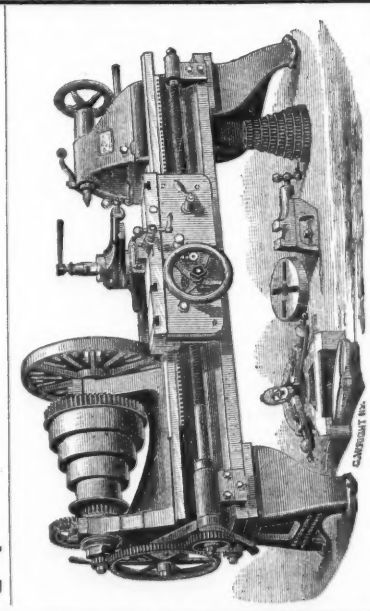

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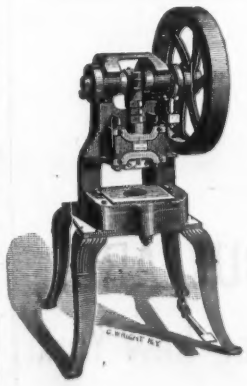

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